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IN THE

# Supreme Court of the United States

October Term, 1987

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**AMERICAN CYANAMID COMPANY,**
*Petitioner,*

*v.*

**THE DOW CHEMICAL COMPANY,**
*Respondent.*

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## PETITION FOR WRIT OF CERTIORARI TO THE UNITED STATES COURT OF APPEALS FOR THE FEDERAL CIRCUIT

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## QUESTION PRESENTED

Where the Federal Circuit has reconstructed the Supreme Court's standard for determining valid patentability under the Patent Laws, resulting in conflicting legal determinations by different three-judge panels, should the Supreme Court restore its controlling precedent?

## RULE 28.1 LISTING

Petitioner, American Cyanamid Company ("Cyanamid") is part owner of each of the following subsidiary corporations. Cyanamid has no parent, and is not affiliated with any other corporations, except wholly owned subsidiaries.

| Subsidiary | Percent Owned |
|---|---|
| Agustin A. Balaguer & Cia. Ltda. | 20 |
| Arizona Chemical Company | 50 |
| B. Braun-Dexon GmbH | 50 |
| B. Braun-Dexon, S.A. | 50 |
| Brewster Phosphates (a Partnership) | 75 |
| Burford Fertilizers Limited | 50 |
| The Catalyst Company (a Partnership) | 50 |
| Ceresdale Fertilizers Limited | 50 |
| Colfax Laboratories (India) Private Limited | 40 |
| Cyanamid Fothergill Limited | 50 |
| Cyanamid Iberica, S.A. | 84 |
| Cyanamid India Limited | 55 |
| Cyanamid Italia S.p.A. | 70 |
| Cyanamid-Ketjen Katalysator B.V. | 50 |
| Cyanamid (Pakistan) Limited | 75 |
| Cyanamid (Portugal) Limitada | 80 |
| Cyanamid Taiwan Corporation | 55 |
| Cyanamire S.r.1. | 55 |
| Cyaneka S.A. | 40 |
| Cyro Industries (a Partnership) | 50 |
| Cytogen Corporation | 15 |
| Societe Anonyme Formica | 99 |
| Formica Espanola S.A. | 51 |
| Formica GmbH & Co. KG. | 95 |
| Formica Plastics Pty, Limited | 60 |
| Kent County Fertilizers Limited | 50 |
| Laboratorios Layre Limitada | 20 |
| Lederle (Japan), Ltd. | 50 |
| Lederle (Nigeria) Limited | 40 |
| Les Engrais Chemiques Levis Limitee | 50 |

| Subsidiary | Percent Owned |
|---|---|
| Engrais Saint-Gregoire Inc. | 50 |
| Mitsui-Cyanamid Limited | 50 |
| Molecular Genetics, Inc. | 8.5 |
| Ralph Dale Fertilizers Limited | 50 |
| Sherkat Sahami Cyanamid-KBC | 50 |
| Skyway Fertilizers Limited | 50 |
| Societe des Aiguilles Suturex (S.A.R.L.) | 85 |
| Societe des Sutures Chirurgicales Robert & Carriere-Lederle | 47 |
| Sutumex, S.A. de C.V. | 51 |
| Takeda Italia, S.p.A. | 50 |
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| Yu Han Cyanamid Inc. | 60 |

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## PETITION FOR WRIT OF CERTIORARI TO THE UNITED STATES COURT OF APPEALS FOR THE FEDERAL CIRCUIT

The Petitioner, American Cyanamid Company ("Cyanamid"), respectfully prays that a writ of certiorari issue to review the judgment and opinion of the United States Court of Appeals for the Federal Circuit, entered in the above-entitled proceedings on April 8, 1987.

## OPINIONS BELOW

The opinion of the United States Court of Appeals for the Federal Circuit is reported at 816 F.2d 617, and is reprinted in the appendix hereto, p. 1a, *infra*.

The memorandum decision of the United States District Court for the Eastern District of Louisiana (Beer, D.J.) is reported at 615 F. Supp. 471, and is reprinted in the appendix hereto, p. 32a, *infra*.

## JURISDICTION

Invoking federal jurisdiction under 28 U.S.C. Sec. 1338(a), the respondent brought a patent infringement suit in the Eastern District of Louisiana. Petitioner, Cyanamid, counterclaimed for a declaration that the respondent's patents are invalid, unenforceable and not infringed. On August 15, 1985, the Eastern District entered a memorandum decision finding that three of respondent's patents were infringed, one patent was not infringed, and held that Cyanamid failed to establish that the patents in suit were invalid. See pp. 49a, 58a-60a, *infra*.

On Cyanamid's appeal, the Federal Circuit on April 8, 1987, entered a judgment and an opinion affirming the Eastern District's legal determination of patent validity. Circuit Judge Davis filed a dissenting opinion indicating

that the Eastern District's judgment should be reversed because legal uniformity with an earlier, closely related decision of the Federal Circuit compelled such a result and because rulings by a less than *in banc* panel must follow the legal determinations of a prior panel. See p. 14a, *infra*.

On April 22, 1987, Cyanamid filed a petition in the Federal Circuit seeking a rehearing and suggesting that a rehearing be conducted *in banc*. On April 23, 1987, the Federal Circuit requested that respondent file a brief commenting on Cyanamid's petition. On June 2, 1987, the Federal Circuit issued an Order denying the petition for rehearing, with Circuit Judge Davis expressly indicating that he would have granted the petition for rehearing. The Federal Circuit, on June 10, 1987, issued a further Order declining the suggestion for rehearing *in banc*.

The jurisdiction of this Court to review the judgment of the Federal Circuit is invoked under 28 U.S.C. Sec. 1254(1).

## STATUTE INVOLVED

35 U.S.C. Sec. 103. Conditions for patentability; non-obvious subject matter.

> A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.
>
> Subject matter developed by another person, which qualifies as prior art only under subsection (f) or (g) of section 102 of this title, shall not preclude patentability under this section where the subject

matter and the claimed invention were, at the time the invention was made, owned by the same person or subject to an obligation of assignment to the same person.

## STATEMENT OF THE CASE

Invoking federal jurisdiction under 28 U.S.C. Sec. 1338(a), respondent brought an action against Cyanamid alleging infringement of four United States patents that relate to a single chemical process: using copper catalysts to change a chemical compound into another chemical compound.[1] Cyanamid challenged the patents as invalid for violating 35 U.S.C. Sec. 103 which requires that only nonobvious subject matter may be patented. See pp. 32a-33a, *infra*.

Prior art references disclose that other chemists had successfully used several copper catalysts, including some claimed in respondent's patents, to carry out the same basic process at issue in this case.[2] The respondent's

[1] The patents in suit relate to a chemical process of using a copper catalyst to convert the members in a family of chemical compounds called nitriles to a corresponding chemical compound in the family called amides. The patents here in suit relate specifically to converting those members of the nitrile family known as olefinic nitriles having 3 to 6 carbon atoms. See pp. 1a-2a, *infra*.

[2] The Reppe prior art patent discloses in Example 2 that a copper catalyst used in respondent's process to convert olefinic nitriles was used to convert another member of the nitrile family called an aliphatic nitrile to its corresponding amide. See pp. 4a, 29a, *infra*. The Watanabe prior art publications disclose that other copper catalysts used in respondent's process to convert olefinic nitriles were used to convert other members of the nitrile family called aromatic nitriles. See pp. 4a-5a, 29a, *infra*. The Greene patent discloses that a copper catalyst, different from those used in respondent's process, will convert *all* members of the nitrile family: aliphatic nitriles, aromatic nitriles and the same olefinic nitriles of 3 to 6 carbon atoms used in respondent's process. See pp. 5a, 19a-20a, *infra*.

process differs from these prior processes only with respect to the specific chemical compounds used as starting materials. See p. 6a, *infra*. Patentability hinged, therefore, on whether that difference rendered the claimed subject matter nonobvious.[3]

In a related case, the Eastern District of Louisiana, through another trial judge, found the same Cyanamid process not to infringe an earlier-issued patent in the same art as respondent's patents in suit here and held the patent invalid.[4] The same principal prior art Cyanamid relies on in this case was before the other district judge in the related case. See pp. 3a-4a, *infra*. On appeal, the Federal Circuit unanimously affirmed the legal determination of obviousness. That panel broadly stated, as a matter of law, that the district judge had correctly found:

> [T]he combined teachings would have indicated to one of ordinary skill in the art that copper was an effective agent for producing a catalysis in the process of converting a nitrile to an amide.

See p. 29a, *infra*. In the present case, decided a year and a half later by a 2 to 1 vote, the Federal Circuit again

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[3] A fundamental principle of organic chemistry states that the chemical behavior of a functional group, such as the nitrile group which identifies a compound as part of the nitrile family, is strongly presumed to be more or less the same from one compound of the family to another. See p. 2a, *infra*. The Greene patent demonstrates this principle in disclosing that the same copper catalyst will convert *all* members of the nitrile family. See p. 5a, *infra*. The prior art Haefele patent discloses that other catalysts likewise will convert *all* members of the nitrile family. *Id.*

[4] Standard Oil Co. v. American Cyanamid Co., 774 F.2d 448 (Fed. Cir. 1985) (hereafter referred to as *Sohio* and reprinted in the appendix hereto, p. 17a, *infra*). In *Sohio*, the Greene patent that is prior art to respondent's patents was held invalid for claiming obvious subject matter in violation of 35 U.S.C. Sec. 103. See p. 29a, *infra*.

reviewed the same prior art but this time affirmed *a completely contrary* conclusion from another district judge in the Eastern District that:

> [T]he hydration of nitriles by the use of a copper catalyst obtained through the reduction of a copper compound was not predictable, and was not obvious.

See p. 52a, *infra*.

In the related case involving the earlier-issued patent held invalid, the record demonstrated that the patented subject matter had never been used commercially, had never been licensed, and no other secondary considerations were present to support validity. See p. 20a, *infra*. The Federal Circuit concluded that the district court's obviousness holding was "entirely correct." See p. 29a, *infra*.

On the other hand, in this case the Federal Circuit focused primarily on "strong objective evidence of nonobviousness in the record as found by the district court." See p. 13a, *infra*. This so-called objective evidence of nonobviousness, the Federal Circuit stated, "lends much to our conclusion that the claimed invention fully satisfies the requirements of 35 U.S.C. 103." See p. 14a, *infra*.

In this case and the earlier related case, the patents both claimed the same basic process and the copper catalysts used, although different from each other, were known in the prior art for use in that process. See pp. 4a-6a, 28a-29a, *infra*. In both cases, the sole "difference" between the claimed process and the prior art lay only in the selection of the particular chemical compounds used in the process. See pp. 5a-6a, 19a, *infra*. In both cases, the relevant prior art and the level of ordinary skill were the same. See pp. 3a, 28a-29a, *infra*. The only factual difference of consequence between the two cases, therefore, was the absence of secondary considerations and

commercialization by the one patentee (Sohio) and the presence of commercialization[5] by the other patentee (Dow) with other secondary considerations.

## REASONS FOR GRANTING THE WRIT

### I. The Federal Circuit Has Devised Its Own, New Standard For Determining Patentability That Reconstructs Prior Supreme Court Precedent And Hinders The Congressional Intent To Promote Stability And Uniformity In The Application Of The Patent Laws

This case demonstrates both a conflict of law within the Federal Circuit and the need for the Supreme Court to exercise its supervisory powers in order to eliminate the conflict between the Federal Circuit's standard for determining patentability and the standard mandated by long-established Supreme Court precedent.[6]

In this case, the Federal Circuit has reconstructed the principles for applying the statutory test of "obviousness"[7] mandated by the Supreme Court in *Graham v. John Deere Co.*[8] to determine whether novel subject matter may be validly patented. Eight circuit courts, prior to the crea-

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[5] The product made by the accused process "is a valuable organic chemical with a growing list of important commercial applications." Its production "is now a major competitive business in the United States." See p. 18a, *infra*.

[6] Congress has provided in 28 U.S.C. Sec. 1254(1) that the Supreme Court may review cases in all the federal courts of appeals by writ of certiorari. When a federal court of appeals has decided a federal question in a way that conflicts with applicable decisions of the Supreme Court, review by writ of certiorari is warranted. Supreme Court Rule 17.1(c). *See, e.g.* United States v. Doe, 465 U.S. 605, 610 (1984) (certiorari granted "to resolve the apparent conflict between the Court of Appeals holding and the reasoning underlying this Court's holding in *Fisher*").

[7] 35 U.S.C. Section 103.

[8] 383 U.S. 1, 17 (1966).

tion of the Federal Circuit, strictly observed the requirements laid down in *Graham*. Those circuit courts adhered to the principle that "secondary considerations" are not controlling on the issue of obviousness and will not override the primary three-part *Graham* inquiry.[9] The Federal Circuit's decision here has revised the Supreme Court standard that is binding on all Federal courts. In consequence, the Federal Circuit has reached a decision in this case which contradicts the proper legal determination of a prior panel.

A comparison of the Federal Circuit's decision in this case (*Dow*)[10] and the conflicting one of the earlier *Sohio* case[11] reveals both the conflict and the instability caused by permitting "secondary considerations" to determine resolution of the obviousness test, contrary to the Supreme Court's prior requirement that the technical background of the prior art and the level of ordinary skill in the art be

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[9] *See* Potter Instrument Co. v. ODEC Computer Systems, Inc., 499 F.2d 209, 211 (1st Cir. 1974); Digitronics Corp. v. New York Racing Ass'n, 553 F.2d 740, 748 (2d Cir. 1977); Philips Electric & Pharmaceutical Industries Corp. v. Thermal & Electric Industries, 450 F.2d 1164, 1174-75 (3rd Cir. 1971); Cathodic Protection Service v. American Smelting & Refining Co., 594 F.2d 499, 513 (5th Cir. 1979); Universal Electric Co. v. A.O. Smith Corp., 643 F.2d 1240, 1248 (6th Cir. 1981); Brunswick Corp. v. Champion Spark Plug Co., 689 F.2d 740, 751-52 (7th Cir. 1982); Stevenson v. Grentec, Inc., 652 F.2d 20 (9th Cir. 1981); Halliburton Co. v. Dow Chemical Co., 514 F.2d 377, 379 (10th Cir. 1975).

[10] Dow Chemical Co. v. American Cyanamid Co., 816 F.2d 617 (Fed. Cir. 1987) (reprinted in the appendix hereto, p. 1a, *infra*).

[11] Standard Oil Co. v. American Cyanamid Co., 774 F.2d 448 (Fed. Cir. 1985) (reprinted in the appendix hereto, p. 17a, *infra*).

controlling.[12] In both cases, the technical background facts were the same. The two cases differed in only one principal respect: the existence of secondary considerations. In *Sohio* the Federal Circuit held the patent invalid but later held respondent's patents valid in *Dow*. In *Sohio* the Federal Circuit stated in holding the patent invalid:

> There evidently being no "secondary considerations" respecting the actual invention of claim 2, the district court's conclusion of obviousness of the subject matter of claim 2 was entirely correct.

See pp. 20a, 29a, *infra*. In *Dow*, the majority stated in holding the patents valid:

> Lastly, the objective evidence of nonobviousness [i.e. secondary considerations], particularly failure of others and long-felt need, lends much to our conclusion

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[12] In *Graham*, this Court ruled:

> Under Sec. 103, the scope and content of the prior art are to be determined; differences between the prior art and the claims at issue are to be ascertained; and the level of ordinary skill in the pertinent art resolved. Against this background, the obviousness or nonobviousness of the subject matter is determined. Such secondary considerations as commercial success, long felt but unsolved needs, failure of others, etc., might be utilized to give light to the circumstances surrounding the origin of the subject matter sought to be patented. As indicia of obviousness or nonobviousness, these inquiries may have relevancy.

*Graham*, 383 U.S. at 17-18. The Supreme Court considered these secondary considerations to be "legal inferences" or "subtests" that "focus attention on economic and motivational rather than technical issues." *Graham*, 383 U.S. at 35-36. The Court appears to consider these factors only relevant in terms of whether they "tip the scales of patentability." *Graham*, 383 U.S. at 36. *See also* Anderson's-Black Rock, Inc. v. Pavement Salvage Co., 396 U.S. 57, 61 (1969) (long felt need and commercial success cannot alone establish patentability).

> that the claimed invention fully satisfies the requirements of 35 USC 103.

See p. 14a, *infra*.

The two-judge majority in *Dow* reached its decision by elevating the "secondary considerations" to the level of a principal factual inquiry and by declining to follow the prior legal determination of obviousness made by the *Sohio* court. The Federal Circuit has reformed the statutory test of nonobviousness characterized in *Graham*, resulting in conflicting legal determinations that hinder the purpose of section 103 of the Patent Act, as declared by Congress:

> This section should have a stabilizing effect and minimize great departures which have appeared in some cases.

House Report No. 1923, 82d Cong., 2d Sess. at 7 (1952).

By transforming "secondary considerations" into "objective evidence of nonobviousness", the Federal Circuit has revised the statutory standard as interpreted by the Supreme Court in *Graham*. In *Dow*, the technical background represented by the scope and content of the prior art, the differences between the prior art and the claimed subject matter, and the level of ordinary skill in the art became essentially irrelevant to the obviousness inquiry in the face of the outcome determinative "secondary considerations." In *Sohio*, however, the same technical facts had compelled a legal determination of obviousness.

In essence, the Federal Circuit has applied two different standards of patentability in *Dow* and in *Sohio*, depending solely upon the absence or presence of "secondary considerations." Thus, two different and contrary obviousness determinations, governing the same alleged patentable distinction over the prior art, have now been made. The conflicting *Sohio* and *Dow* decisions are the consequence of the differing assessment by different panels of the same court of perceived *subjective* "secondary

considerations" and not the objective statutory methodology mandated by the Supreme Court.[13] Only strict observance of the requirements of *Graham* can ensure the uniformity and definiteness which Congress intended to promote through the 1952 Act and the creation of the Federal Circuit.

## II. The Principle Of Precedent And The Doctrine Of Stare Decisis Compel Rejection Of The New Standard Embraced By The Federal Circuit

Various three-judge panels of the Federal Circuit have openly labelled and adopted secondary considerations as the "fourth prong" of the Graham three-prong test.[14] In doing so, the Federal Circuit has relied upon the Federal Circuit and not the Supreme Court[15] as precedent authority.[16]

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[13] Petition for rehearing and suggestion for rehearing *in banc* of the conflict between panels was denied by the Federal Circuit, one judge common to both panels dissenting. The petition was based upon Circuit Judge Davis' strong dissent: "In my view, a contrary result is compelled by this court's earlier decision in *Standard Oil Co. v. American Cyanamid Co.*, 774 F.2d 448, 227 U.S.P.Q. 293 (Fed. Cir. 1985) (*Sohio*)." See p. 14a, *infra*.

[14] Loctite Corp. v. Ultraseal Ltd., 781 F.2d 861, 873 (Fed. Cir. 1985).

[15] In its very first reported decision, the Federal Circuit identified the case law it deemed appropriate to serve as established precedent:

> Other than that created by our predecessor courts [United States Court of Claims and the United States Court of Customs and Patent Appeals], no body of law established by any other court or set of courts would appear a suitable candidate for adoption.

South Corp. v. United States, 690 F.2d 1368, 1371 (Fed. Cir. 1982).

[16] Simmons Fastener Corp. v. Illinois Tool Works, 739 F.2d 1573, 1575 (Fed. Cir. 1984).

The Federal Circuit's various three-judge panels[17] by internal cross-citing, have confirmed and applied the co-equality of secondary considerations with the three primary ones:

> They should be considered as a *fourth* factual inquiry under *Graham* before coming to a conclusion concerning obviousness.[18]

This creation of a new standard by the Federal Circuit, which may even override this Court's *Graham* standard, has not gone unnoticed by commentators:

> Increased emphasis may be desirable [in special jury verdicts] but recently the Court has elevated secondary considerations, specifically commercial success, *to a level above* the tripartite inquiry of *Graham*.[19] (Emphasis added.)

A review of the decisional consequences reveals not only the conflict, unresolved *in banc*, between *Sohio* and this case but also the statistical revelation of an overwhelming favoring by the Federal Circuit of commercial success and other secondary considerations as the determinant for nonobviousness patentability. If the patented invention has been commercialized or other secondary considerations are present, then it is virtually certain to be held valid by the Federal Circuit. On the other hand, if no secondary considerations are present and

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[17] All of the relevant decisions of the Federal Circuit have been made by three-judge panels. The Federal Circuit has not spoken *in banc* on the reliance upon secondary considerations as a determinant of nonobviousness co-equally with the three primary technical considerations of *Graham*.

[18] Vandenberg v. Dairy Equipment Co., 740 F.2d 1560, 1567 (Fed. Cir. 1984).

[19] Coolley, *Obviousness: Jury Determination and Review by the Federal Circuit Court of Appeals*, 67 J. Pat. Off. Soc'y 201, 212 (1985). *See also* Walker, *Objective Evidence of Nonobviousness: The Elusive Nexus Requirement (Part I)* 69 J. Pat. Off. Soc'y 175 (1987).

especially if the subject matter patented has not been commercially exploited, the likelihood is that the Federal Circuit will hold the patent invalid.[20]

A standard for patentability tied primarily to whether the subject matter has been commercially exploited runs counter to the philosophical underpinnings of the patent system: to promote disclosure of scientific and technical achievements that will advance the progress of the useful arts. Those inventors without the capability of commercializing an invention will have no incentive to disclose their work through patents if the exclusive rights they receive will likely be declared invalid if later challenged. On the other hand, those with the capacity will most certainly seek the acquisition of patent rights even if the technical assessment of patentability of the subject matter is in doubt. The Federal Circuit's reconstructed standard, with one decisional exception, protects only patents directed to commercial subject matter and discourages disclosure through patents of meritorious inventions that may not have yet been commercially exploited.

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[20] Where there is any evidence of purported commercial success or other secondary considerations, the Federal Circuit has found or affirmed nonobviousness and validity in 41 cases, but invalidity because of obviousness in only *1 case*, EWP Corp. v. Reliance Universal Inc., 755 F.2d 898, 907 (Fed. Cir. 1985). Where there was either no evidence of commercial success and other secondary considerations, or where such evidence was discounted, obviousness and invalidity were found by the Federal Circuit in 22 cases, but nonobviousness and validity in only *1 case*, Leinoff v. Louis Milona & Sons, Inc., 726 F.2d 734, 740 (Fed. Cir. 1984).

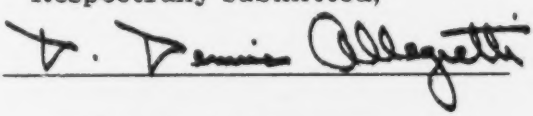
## CONCLUSION

In *Sohio*, the legal conclusion of obviousness and consequent patent invalidity was compelled by the three primary technical fact considerations mandated by this Court under *Graham*. In this case (*Dow*), however, that prior, proper legal determination was not followed by another panel of the Federal Circuit solely because of the overriding application of "secondary considerations" present in *Dow* but not present in *Sohio*.

Such conflicting results were not resolved *in banc*, and are the consequence of the Federal Circuit's reconstruction of the standard mandated by the binding precedent of *Graham*.

This Court should intervene to restore its controlling precedent.

Respectfully submitted,



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# APPENDIX

UNITED STATES COURT OF APPEALS
FOR THE FEDERAL CIRCUIT

THE DOW CHEMICAL COMPANY,

*Appellee,*

*v.* No. 85-2749

AMERICAN CYANAMID COMPANY,

*Appellant.*

April 8, 1987

**OPINION:**

Before MARKEY, Chief Judge, RICH, and DAVIS, Circuit Judges.

RICH, Circuit Judge.

This appeal is from the final Judgment of the United States District Court for the Eastern District of Louisiana, 615 F. Supp. 471, 229 USPQ 171 (1985), holding that certain claims of plaintiff-appellee Dow Chemical Company's (Dow.) U.S. Patents No. Re 31, 430 ('430 reissue patent), No. 3,994,973 ('973 patent), and No. 3,642,894 ('894 patent), are not invalid and were infringed by defendant-appellant American Cyanamid Company (Cyanamid), and that Dow's U.S. Patent No. Re 31,356 (the '356 reissue patent) is not invalid but was not infringed by Cyanamid. The parties do not in this appeal challenge the findings on the infringement issue. We affirm the judgment on the issue of the validity of the claims in suit.

## I. BACKGROUND

The four patents in suit relate to a chemical process of using a copper catalyst to convert an olefinic nitrile

having 3 to 6 carbon atoms to its corresponding amide. Dow asserted that Cyanamid infringed its patents by using a process for catalytically converting acrylonitrile to acrylamide with a copper catalyst prepared by reducing a combination of copper compounds.

**A. The Chemistry**

Acrylonitrile is a commonly produced chemical, and its conversion to acrylamide is an extremely valuable commercial process. That process, in which water is combined with acrylonitrile to produce acrylamide, is known as a "hydration" process, more specifically the "hydrolysis" of a nitrile, acrylonitrile, to its corresponding amide, acrylamide.

A nitrile is an organic compound containing a carbon-to-nitrogen triple bond and, depending on the rest of the molecule, can be classified as either aromatic or aliphatic. Aliphatic compounds can be either saturated or unsaturated. A saturated aliphatic compound is one in which all the bonds between the carbon atoms are single bonds, while an unsaturated compound is one in which at least two carbon atoms are joined by double (olefinic) or triple (acetylenic) bonds. Acrylonitrile is an unsaturated aliphatic nitrile, more specifically an olefinic nitrile expressed by the chemical formula $CH2=CH-C=N$.

In the hydrolysis or hydration of acrylonitrile to acrylamide, a molecule of water reacts with the nitrile group of the acrylonitrile molecule to form acrylamide, $CH2=CH-CONH2$. The conventional industrial method of producing acrylamide involves mixing acrylonitrile with sulfuric acid and water to form acrylamide sulfate, which is then decomposed to acrylamide by reaction with ammonia, resulting in the formation of the by-product ammonium sulfate as well as acrylamide. The process now used by both Dow and Cyanamid, however, involves con-

tacting the acrylonitrile with water in the presence of a copper catalyst, thereby forming acrylamide directly without the formation of any by-products.

For the purposes of this appeal, Cyanamid apparently concedes that its method for producing acrylamide would infringe the Dow patents. Cyanamid contends, however, that the Dow patents are invalid for claiming "unpatentably obvious" subject matrer, arguing that one of ordinary skill in the art, who would be a Ph.D. chemist with industrial experience, having knowledge of the prior art, would have predicted and expected that certain copper catalysts, which had been employed generally in the nitrile conversion process, would also convert acrylonitrile to its corresponding amide.

The chemical process at issue is generally similar to the process that was at issue in *Standard Oil Company v. American Cyanamid Company*, 774 F.2d 448, 227 USPQ 293 (Fed. Cir. 1985) (*Standard Oil*). In that case, this court affirmed a decision of Judge George Arceneaux of the same United States District Court for the Eastern District of Louisiana, holding claim 2 of Standard Oil's U.S. Patent No. Re 25,525 (the Greene patent) invalid for obviousness. The Greene patent also claimed a process for converting acrylonitrile to acrylamide using a different copper catalyst. In the *Standard Oil* case, the district court relied on two prior art references in support of its conclusion. Those references were U.S. Patent No. 1,891,055, issued in 1932 to Walter Reppe (the Reppe patent) and a series of articles written by Dr. Kenichi Watanabe (the Watanabe articles). Those same two references, along with the Greene patent and U.S. Patent No. 3,669,639, issued to Louis Haefele in 1968 (the Haefele patent), constitute the principal prior art which Cyanamid here asserts renders the Dow patents in suit invalid.

We note additionally that although the Standard Oil case and this one involve generally similar conversion processes—acrylonitrile to acrylamide using a copper catalyst—, the claims, patents, and records in these cases are dissimilar and thus we are in no way bound by that prior decision.

**B. The Prior Art**

**1. The Reppe Patent**

The Reppe patent, No. 1,891,055, uses copper catalysts to carry out the *hydrogenation* (the direct addition of *hydrogen* to the carbon-carbon bond of an unsaturated nitrile, to form a saturated nitrile, as distinguished from hydration, which is the addition of water to the carbon-nitrogen bond) of unsaturated nitriles to form an unsaturated amide. It discloses, inter alia, that *after* hydrogenation and *separation* of the copper catalysts from the reaction mixture, the saturated nitriles can be converted to their corresponding amides by the addition of water. Example 2 of the Reppe patent discloses the formation of propionitrile, a saturated aliphatic nitrile and its corresponding amide, propionamide, from crude acrylonitrile, using a catalyst prepared by the reduction of copper carbonate.

**2. The Watanabe Articles**

Dr. Watanabe published a series of articles[1] confirming the efficacy of hydrating aliphatic and aromatic nitriles to their corresponding amides using metallic nickel catalysts. Dr. Watanabe also used metallic copper catalysts but with poor results; he stated that they were not as useful because of undesirable side reactions. A 1964 Watanabe article reports the details of experiments con-

[1] 37 Bull. Chem. Soc'y Japan 1325-29 (1964); 39 Bull. Chem. Soc'y Japan 8-14 (1966).

verting benzonitrile (an aromatic nitrile) to benzamide using, inter alia, copper catalysts, including precipitated copper, copper oxide and Urushibara copper, which is a metallic copper prepared by the reduction of copper chloride. The results of the experiments reported indicated that when the Urushibara copper catalyst was used to convert an aromatic nitrile to its corresponding amide the results were unsatisfactory.

**3. The Greene Patent**

The U.S. Greene patent, No. 3,381,034 (reissued as Re 28,525), discloses a homogeneous catalytic system consisting of soluble copper ions alone or in combination with metallic copper ions that will convert aromatic and aliphatic nitriles to their corresponding amides. The patent states that metallic copper alone is *not* an effective catalyst for converting acrylonitrile to acrylamide.

**4. The Haefele Patent**

The Haefele U.S. patent, No. 3,366,639, describes the use of large amounts of the catalyst manganese dioxide to accomplish the hydration of a variety of nitriles, including aromatic, aliphatic, and olefinic nitriles, to their corresponding amides. It does not disclose the use of copper or any catalyst other than manganese dioxide but does state that its process is applicable to production of amides from nitriles in general.

**C. The Patents at Issue and Their Prosecution**

All of the Dow patents at issue here are continuations-in-part of an application filed in January of 1969 that eventually matured into U.S. Patent No. 3,597,481 (the '481 patent). The four patents that are asserted by Dow to be infringed by Cyanamid here are continuations-in-part of a June 1969 application that eventually became U.S. Patent No. 3,631,104 (the '104

patent), which was a continuation-in-part of the '481 patent application. The '104 patent was reissued as the '430 reissue patent on October 25, 1983.

**1. The '430 Reissue Patent**

The original claims of the '104 patent were directed to a process for converting aliphatic nitriles in general to their corresponding amides in the presence of a copper catalyst prepared by reducing various copper oxides. On February 26, 1981, ten years after the '104 patent issued, Dow filed a "no defect" reissue application, in which it disclosed several new references to the Patent and Trademark Office (PTO), including the German equivalent of the Reppe patent.

In the first office action on the reissue, the examiner rejected all claims directed to the hydration of aliphatic nitriles in general as obvious in view of the German Reppe patent. In response, Dow conceded that the Reppe patent disclosure might render their broader claims obvious but maintained that it disagreed with the examiner's decision. Dow proposed limiting the claims to hydration of olefinic nitriles of 3 to 6 carbon atoms, and the claims were then allowed.

Claim 26 of the '430 reissue patent, the one considered by the district court, reads:

> 26. The process of claim 16 wherein the nitrile is acrylonitrile.

Claim 16, not in issue, reads:

> 16. In the process for converting a nitrile to the corresponding amide by contacting an olefinic nitrile of 3 to 6 carbon atoms in the presence of water with a heterogeneous catalyst, the improvement comprising using a cupreous catalyst consisting essentially of reduced copper oxide, reduced copper chromium oxide, reduced copper-molybdenum oxide, unreduced copper-molybcenum oxide or mixtures thereof.

### 2. The '894 Patent

The first of a number of applications filed by Dow as continuations-in-part of the '104 patent application issued as the '894 patent. Claim 6, the one claim considered by the district court, is directed to the same basic process for converting an acrylonitrile to its corresponding amide. The difference between this claim and claim 26 of the '430 reissue patent is an additional step of "at least partially protecting the reduced catalyst from contact with oxygen after reduction."

### 3. The '973 Patent

The '973 patent is similar to the '430 reissue patent. Claim 13, the only claim considered by the district court, defines a process for converting an acrylonitrile to its corresponding amide "in the presence of a catalytic amount of copper prepared by reducing copper oxide." The district court held claim 13 infringed by Cyanamid.

### 4. The '356 Reissue Patent

A fourth Dow patent, also a continuation-in-part of the application for the '104 patent, issued September 11, 1973, as No. 3,758,578 (the '578 patent) and was reissued August 23, 1983, as the '356 reissue patent. Claim 10, the only claim in suit, defines the process of converting acrylonitrile to acrylamide using a copper salt catalyst. The district court held that claim 10 was not infringed because it found that the catalysts used by Cyanamid were prepared by reducing copper oxides, not copper salts.

## D. The Objective Evidence of Nonobviousness

The record indicates that there was a long-felt need to find a better way to manufacture acrylamide than by the sulfuric acid process. Dow urges that the shift to a catalytic process by both Dow and Cyanamid and Cyanamid's admitted adoption of a process based inter alia on

information gleaned from the Dow patents are both objective factors tending to support the patentability of Dow's claimed process. Cyanamid argues that there was no evidence of nexus between the commercial success of Dow's acrylamide business and any aspect of the claimed invention, and further urges that the commercial success enjoyed by both Dow and Cyanamid was more probably attributable to a market demand for acrylamide.

Cyanamid conceded that the Dow patents provide one common disclosure to the public of a chemical process for the conversion of nitriles to amides, but noted at trial that the only distinction of Dow's invention from prior known processes is Dow's claim limitation to one subgroup of nitriles, namely, olefinic nitriles of 3 to 6 carbon atoms. Thus, Cyanamid asserted that the subject matter of the patents as a whole would have been obvious to one of ordinary skill in the art at the time that Dow's inventions were made. With respect to the obviousness of the claimed invention, Dow asserted that Cyanamid's copying of Dow's process, the great need to commercialize the process, and the commercial success enjoyed by Dow were compelling evidence of nonobviousness.

Trial to the district court sitting without a jury lasted seven days, during which time the district court heard the testimony of one of the Dow patentees, Dr. Ben Tefertiller, as well as two chemical experts on behalf of Cyanamid and an expert in the field of patent practice on behalf of Dow. The district court issued its decision, including findings of fact and conclusions of law, on August 14, 1985.

## II. THE DISTRICT COURT'S OPINION

The only district court conclusion at issue is the legal question of nonobviousness. In addressing it the district court first noted the *Graham* inquiries, emphasizing objec-

tive evidence of nonobviousness such as long-felt need, unexpected results, commercial success and failure of others.

The court then turned to an analysis of the prior art and a comparison of each reference with the claimed invention, which the court characterized as "the hydration of acrylonitrile to acrylamide using a reduced copper compound as a catalyst." In discussing the Reppe patent, the district court found that it taught that reduced copper catalysts are useful for the hydrogenation of unsaturated nitriles to the corresponding saturated nitriles and that after hydrogenation the saturated nitrile can be converted to an amide by the addition of water. The district court concluded its analysis by stating that the Reppe patent "does not disclose the hydration of acrylonitrile to acrylamide using a reduced copper catalyst."

The district court found that the Watanabe articles indicated that the hydration of aliphatic nitriles was somewhat different from the hydration of aromatic nitriles, and that metallic copper catalysts "gave poor results as catalysts for hydration." In addition, the court noted that "Dr. Watanabe taught that the catalysts could be exposed to air during their preparation." The court concluded with the statement that "[t]he reference does not disclose the hydration of acrylonitrile to acrylamide with a reduced copper compound as a catalyst."

The district court acknowledged that the Greene patent taught that soluble copper ions would convert aromatic and aliphatic nitriles, including acrylonitrile, to their corresponding amides" but also found that it stated "that metallic copper alone was not an effective catalyst for converting acrylonitrile to acrylamide." Similarly, the court noted that the Haefele patent "disclosed the use of large amounts of manganese dioxide as a catalyst with an organic solvent to convert nitriles, including acrylonitrile,

to the corresponding amide," but found that "[t]he reference does not disclose the use of a reduced copper compound to catalyze the hydration of acrylonitrile to acrylamide."

The court then concluded "that there are differences between the subject matter claimed by Dow in the patent-in-suit [sic] and the prior art when taken as a whole, and that such differences would not be [sic, have been] obvious to those skilled in the art." The court found those differences to be, inter alia that "the hydration of nitriles by the use of a copper catalyst obtained through the reduction of a copper compound was not predictable." The court also stated that the process claimed in the Dow patents was "limited to the conversion of certain unsaturated nitriles, particularly acrylonitrile, to its corresponding unsaturated amide." The court found that process to be different "from the prior art in the nature of the nitrile hydrated" because the prior art showed the hydration of only "saturated and aromatic nitriles."

Finally, the district court acknowledged several secondary considerations to support its conclusion that the Dow patents had not been proven invalid. The court found that Dow was able to build a full-size plant, utilizing its patented invention to replace the sulfuric acid process. The court was also impressed by the fact that the Dow process "produces high yields of pure acrylamide . . . with little or no by-product." That fact, coupled with Cyanamid's apparent inability to develop its own commercial process based on the prior art, indicated to the court that Dow's patented invention would not have been obvious.

Two weeks later the court issued its judgment, holding the '430 reissue patent, the '894 patent, the '973 patent, and the '356 reissue patent valid and enforceable. The court then held that Cyanamid infringed claim 26 of

the '430 reissue patent, claim 6 of the '894 patent, and claim 13 of the '973 patent, and permanently enjoined Cyanamid from practicing the processes of those claims.[2] The injunction was stayed pending appeal to this court.

## III. OPINION

The district court correctly recognized that Reppe discloses a process in which unsaturated nitriles are converted to saturated ones by using a copper catalyst and in which the *saturated* nitrile is then converted to its corresponding amide but *without* the use of the copper catalyst as in the claimed inventions. The disclosure is of a two-step process, and the district court acknowledged that distinction in making its *Graham* inquiry.[3]

The district court recognized that the Watanabe articles disclose the use of copper catalysts to successfully convert aromatic and aliphatic nitriles to their corresponding amides, and Watanabe's statement that "[i]t has been found that the usual catalysts for hydrogenation are generally effective in the hydration of nitriles." The

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[2] It would be inappropriate for a district court to state in its judgment form that four *patents* are valid if only one claim of each were asserted and tried. *See* 35 USC Sec. 282. In this case, there is no indication that the four claims tried were stipulated as "representative," and the district court mentioned but did not specifically rule on Cyanamid s counterclaim for a declaratory Judgment of patent invalidity. The district court should consider whether its judgment with respect to validity should be recast to limit it to the claims in suit.

[3] We are not persuaded by Dow's so-called concession during prosecution that Reppe "can be interpreted as disclosing the formation of aliphatic amides from the corresponding aliphatic nitriles using copper catalysts" because this evidence is ambiguous, was before the district court, and we may not redetermine its weight and credibility. *See Inwood Laboratories, Inc. v. Ives Laboratories*, 456 U.S. 844, 856, 214 USPQ 1, 7 (1982).

court found that Watanabe did not suggest the use of copper catalysts to convert acrylo-nitrile to acrylamide because his results showed that the yields of amide obtained in such a manner were very poor compared to the use of nickel catalysts, that copper catalysts gave unexpected side reactions, and that some copper catalysts caused the formation of amines rather than amides, all of which would have suggested the undesirability of a process as defined by the claims in issue. There is nothing in the record to support a conclusion that these findings are clearly erroneous, and thus we are not convinced that a mistake has been made.

The Greene reference shows that a catalyst composed of the *combination* of soluble copper ions and metallic copper will convert a wide range of nitriles to amides, including olefinic nitriles of 3 to 6 carbon atoms and specifically including acrylonitrile. That art also explicitly states, as found by the district court, that copper metal *alone* "is not an effective catalyst for [converting a nitrile to its corresponding amide]," and to that extent teaches away from the claimed invention's use of copper metal as a catalyst.

The Haefele patent relates only to the use as a catalyst of manganese dioxide to convert numerous different nitriles. The present case is concerned with copper catalysts.

With regard to objective evidence of nonobviousness, the district court found that "Dow's efforts were successful, not only scientifically, but also commercially in that Dow was able to build a full-size plant utilizing its patented invention that replaced the sulfuric acid process." The record reflects that this success was possible because the claimed invention unblocked a cost barrier to the market; it displaced the prior inefficient process bur-

dened with the costs of extra reagents and an ammonium sulfate by-product. While Cyanamid's argument that Dow has not shown that its increase in sales resulted from the claimed invention may be well taken, there is other strong objective evidence of nonobviousness in the record as found by the district court.

The finding that the claimed invention resolved a long-felt need to do away with the wasteful sulfuric acid process and its unwanted by-products tends to show the nonobviousness of the claimed invention as does failure of others and copying; Cyanamid tried but failed to develop the claimed invention and copied it instead.

Based on all of the above, we conclude that the subject matter of the four claims of the four patents in suit would not have been obvious to one of ordinary skill in the art at the time those inventions were made. The Reppe prior art discloses copper metal catalysts and hydration, but when the distinction between using that copper catalyst in hydrogenation and not in hydration is made, that disclosure is not meaningful to the obviousness of the claimed invention; in Reppe, the copper catalyzed the saturation of the carbon-carbon bonds of the nitrile, not its hydration, to an amide, the subject matter of the claims in suit. The fact that the 1964 Watanabe article states that the usual hydrogenation catalysts are "generally effective" in the hydration of nitriles to amides might suggest the claimed invention when viewed in combination with Reppe if it were not for the fact that Watanabe also states that copper metal catalysts give *poor* yields and unexpected side reactions, the first of which the court found the claimed invention *excelled* in. Furthermore, taking the Greene reference as a whole in combination with Reppe and Watanabe, we can only conclude that its explicit statement that copper catalysts were ineffective for use in hydrating nitriles would lead one of ordinary skill in the

art away from the claimed invention. Finally, the Haefele prior art adds little to the equation of obviousness. Lastly, the objective evidence of nonobviousness, particularly failure of others and long-felt need, lends much to our conclusion that the claimed invention fully satisfies the requirements of 35 USC Sec. 103.

## IV. CONCLUSION

Accordingly, the district court's holding that the claims in suit of the four patents in suit, Re 31,430, No. 3,994,973, No. 3,642,894, and Re 31,356, are not invalid is *affirmed.*

**AFFIRMED.**

**DAVIS, Circuit Judge, dissenting.**

## I.

In my view, a contrary result is compelled by this court's earlier decision in *Standard Oil Co. v. American Cyanamid Co.*, 774 F.2d 448, 227 USPQ 293 (Fed. Cir. 1985) (*Sohio*).[1] The chemical process involved here is substantially the same process at issue in *Sohio*, although the challenged patents are different. Because of the general identity of the chemical process, there are holdings in Sohio that bear directly on the correctness of the District Court's decision in this case. The most important of these is our *Sohio* holding that the District Court there correctly "found that the combined teachings [of the Watanabe article and Reppe patent][2] would have in-

[1] *Sohio* came to us on appeal from the same District Court as tried the current suit (the Eastern District of Louisiana) but from a different judge of that court.

[2] These two references are likewise present in the current case.

dicated to one of ordinary skill in the art that copper[3] was an effective agent for producing a catalysis in the process of converting a nitrile to an amide." 774 F.2d at 455, 227 USPQ at 298.[4] This was a legal determination of obviousness, but in the current case Judge Beer made the precisely contrary determination that "the hydration of nitriles by the use of a copper catalyst obtained through the reduction of a copper compound was not predictable, and was not obvious." Because *Sohio* is a binding legal precedent on this exact point,[5] the District Court's contrary legal holding should not stand. But that erroneous holding of the District Court was a mainstay of its opinion sustaining the validity of the patents at issue in this case.

## II.

Spelling out the matter somewhat further, my thought is that the District Court erred, as a matter of law, in holding that the Dow patents would not have been obvious under 35 U.S.C. Sec. 103. The court first discussed each of the pertinent prior art references separately and, on that basis, was able to conclude that none of those references specifically disclosed the hydration of acrylonitrile to acrylamide using a reduced copper compound. It goes without saying, however, that it is not necessary, under Sec. 103, that each and every element of the claimed invention be disclosed in a prior art reference.

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[3] The *Sohio* courts made no distinction between copper in its ionic state and reduced metallic copper as used in the catalytic conversion at issue.

[4] Our *Sohio* opinion also specifically upheld that District Court's appraisal of the Watanabe and Reppe references. 774 F.2d at 454-55, 227 USPQ at 298.

[5] I do not rely at all on principles of former adjudication (res judicata) but on the rule that a less than in banc panel of this court is required to follow the legal determinations of a prior panel.

Such an analysis is properly addressed only for the issue of anticipation under 35 U.S.C. Sec. 102. *W.L. Gore & Assocs. v. Garlock, Inc.*, 721 F.2d 1540, 1554, 220 USPQ 303, 313 (Fed. Cir. 1983), cert. denied, 469 U.S. 851 (1984). Rather, the proper analysis under Sec. 103 is whether the invention, taken as a whole, would have been obvious to one skilled in the art. *Environmental Designs Ltd. v. Union Oil Co.*, 713 F.2d 693, 398, 218 USPQ 865, 870 (Fed. Cir. 1983) *cert. denied*, 464 U.S. 1043 (1984).

While the District Court did make two conclusions on obviousness purportedly based on the prior art considered as a whole, to my mind both conclusions must be rejected. First, the court decided that the prior art taught that the hydration of nitriles was not obvious since it was not predictable. As discussed *supra*, this conclusion runs directly contrary to this court's holding in *Sohio* and therefore should not be accepted since it involved the identical prior art. Second, the court concluded that the "process claimed in the Dow patents, therefore, differ fromthe prior art in the nature of the nitrile hydrated and the nature of the resultant amide" (e.g., acrylo-nitrile hydrated to acrylamide). This conclusion is unsupported by the District Court's own opinion which acknowledged that the Greene Patent (U.S. Letters Patent 3,381,034) taught that a copper catalyst could be used to convert "aromatic and aliphatic nitriles, including acrylonitriles, to their corresponding amides."

I would reverse the decision of the District Court.

UNITED STATES COURT OF APPEALS
FOR THE FEDERAL CIRCUIT

**THE STANDARD OIL COMPANY,**
*Appellant/Cross-Appellee,*

v.

**AMERICAN CYANAMID COMPANY,**
*Appellee/Cross-Appellant.*

Appeal Nos. 84-1519 and 84-1552

September 25, 1985

**OPINION:**

**Before RICH and DAVIS, Circuit Judges, and COWEN, Senior Circuit Judge.**

**RICH, Circuit Judge.**

This appeal is from the final judgment of the United States District Court for the Eastern District of Louisiana, entered on May 31, 1984[1] dismissing the complaint and based on the holding that U. S. Reissue Patent No. 28,525, entitled "Process for Hydrolyzing Nitriles," assigned to plaintiff-appellant/cross-appellee The Standard Oil Co. (Sohio) by the inventors, Janice L. Green and Murrel Godfrey, is invalid and, if valid, not infringed by defendant-appellee/cross-appellant American Cyanamid Company (Cyanamid). Cyanamid also cross-appeals from the district court's failure to award attorney fees and costs against Sohio under 35 USC Sec. 285. We *affirm* the district court's judgment and *remand* for affirmative action on attorney fees.

[1] This judgment, dated May 28, 1984, was entered pursuant to the court's opinion of April 10, 1984, published at 585 F. Supp. 1481, 224 USPQ 210.

## Background

This patent infringement action involves a catalytic process used primarily to manufacture acrylamide ($CH_2=CH-CONH_2$), which is a valuable organic chemical with a growing list of important commercial applications. It has been described by the parties hereto as the precursor for compounds used in pollution control and energy development and as "a preferred starting material" for the production of polymers used in municipal and industrial water treatment, pulp and paper processing, textile treatment, food processing, and other applications. The production of acrylamide is now a major competitive business in the United States.

Acrylamide is a monomer, made by combining a molecule of water with a molecule of acrylonitrile. Prior to the 1960's, acrylamide was produced by a two-step process, usingsulfuric acid and ammonia. The two-step process had several drawbacks, consuming large quantities of sulfuric acid and ammonia while producing a relatively low yield of acrylamide and also resulting in a by-product (ammonium sulfate) not always easily or profitably disposed of.

In June, 1965, two of Sohio's research chemists applied for a patent on a one-step process which produced acrylamide from acrylonitrile by using a copper catalyst. On April 30, 1968, U.S. Patent No. 3,381,034 (the "original Greene patent") was issued to Sohio as assignee of Dr. Janice Greene and Mr. Murrel Godfrey.

In September, 1973, John Jones, one of Sohio's patent attorneys who prepared and prosecuted the original Greene patent application, learned of a 1964 Japanese article by Dr. Kenichi Watanabe (the "Watanabe article") which he felt was relevant to the validity of the original Greene patent but had not been presented to or consid-

ered by the patent examiner. The Watanabe article related primarily to the use of metallic nickel as a catalyst but also directed a catalytic conversion of an aromatic nitrile, benzonitrile, to its corresponding amide, benzamide, by using a catalyst known as Urushibara copper.

After discussing the Watanabe article with Dr. Greene, who affirmed that she had not seen the article before she and Godfrey applied for the patent, Jones filed an application on behalf of Sohio to reissue the original Greene patent. The specification and claims of the reissue application were identical to the original Greene patent except for the removal of all references to the conversion of aromatic nitriles and benzonitrile, which the original patent had included within the invention disclosed and claimed, both generically and specifically. The examiner originally rejected all claims of the reissue application as being obvious in view of the Watanabe article. After a personal interview in which attorney Jones pointed out that the Watanabe article disclosed the use of Urushibara copper, which, he argued, is metallic copper and outside the scope of the claims in the reissue application, the examiner allowed the reissue application. The patent was reissued on August 19, 1975, as Reissue No. 28,525 (the "Greene reissue patent").

Claim 2 of the Greene reissue patent reads, in pertinent part,

> The process for hydrolyzing a nitrile ... comprising contacting said nitrile with water ... in the presence of copper ion, said copper ion being at least partially soluble in water, the nitrile or in both water and nitrile and said copper ion being composed of copper in a combined valence of state of Cu degrees + Cu+, Cu degrees + Cu++, or Cu degrees + Cu+ + Cu++ ....

Since the original Greene patent issued in 1968, numerous patents have issued on the basic process dis-

closed therein. Today, every known manufacturer of acrylamide throughout the world uses a one-step process employing a copper catalyst. In the United States, acrylamide is currently manufactured by Cyanamid, Dow Chemical Company, and Nalco Chemical Company.

Sohio manufactured acrylamide through its subsidiary Vistron from 1969 to 1975 but did so using the sulfuric acid/ammonia process. Sohio has not made acrylamide since June, 1975, and has never commercially manufactured an amide from a nitrile by the process claimed in the Green reissue patent, nor has it marketed a catalyst or had a licensee under that patent.

### The Cyanamid Process

Cyanamid manufactured acrylamide from acrylonitrile and water using the sulfuric acid/ammonia process beginning in 1954, and discontinued use of that process in 1977. Beginning in August, 1968, Cyanamid undertook a project to develop a catalytic process for the selective conversion of acrylonitrile and water solely to acrylamide. Since September, 1973, Cyanamid has operated a process using a "metallic copper catalyst," to be distinguished from copper ion, to catalyze conversion of acrylonitrile to acrylamide. The catalyst used in Cyanamid's process is essentially pure metallic copper (Cu degrees, or zero valence copper), produced by passing hydrogen gas over pellets composed of copper compounds to reduce them to metallic copper. Although Cyanamid takes steps to insure that no copper ions (Cu+ or Cu+ +, copper with a valence number of one or two) are introduced into the process, tests of Cyanamid's reactor effluent showed that it contained minute quantities of soluble copper ions, on the order of one or two parts per million, referred to by the trial judge as "minute."

In October, 1974, Sohio believed that Cyanamid might be using its patented process in its commercial acrylamide plant in Fortier, Louisiana. Although Sohio offered Cyanamid a license under the original Greene patent in December, 1974, Cyanamid took the position that it did not need a license, and there were no further negotiations between the parties. Sohio filed this suit on April 6, 1980, after reissuing its patent, seeking compensation for patent infringement in the form of a reasonable royalty and, in addition, seeking increased damages and attorney fees for willful infringement. Cyanamid denied infringement and counterclaimed for a declaration that the Greene reissue patent is invalid and unenforceable because of fraud and also sought an award of attorney fees against Sohio for bringing a "baseless infringement suit."

**The District Court's Opinion**

Trial was to the court without a jury. Sohio asserted infringement of only claim 2 of the Greene reissue patent. We shall now briefly summarize the court's extensive opinion.

The district court held that the Greene reissue patent was not infringed by Cyanamid. While Sohio's patented process makes use of copper ions that are "at least partially soluble in water, the nitrile or in both water and nitrile," the court specifically found that the catalyst used by Cyanamid is not "at least partially soluble" and also found that the Cyanamid metallic copper catalyst was specifically disclaimed by Sohio in its reissue application.

The court also held that the Greene reissue patent was invalid because it did not satisfy the disclosure requirements of 35 USC Sec. 112 and because the claimed invention was obvious under 35 USC Sec. 103. The court

found (with some confusion on its part discussed infra) that the term "at least partially soluble" as used in claim 2 did not meet the "full, clear, concise and exact" requisites of the first paragraph of Sec. 112 and also held that "partially soluble" was too vague to meet the requirement that the inventor shall particularly point out and distinctly claim the invention, as required by the second paragraph of Sec. 112.

The court went on to hold claim 2 invalid for obviousness under Sec. 103 based on two prior art references, U.S. Patent No. 1,891,055, issued in December, 1932, to Walter Reppe (the "Reppe patent") and the Watanabe article. After examining the disclosures in these references, the court concluded that, when read together, they rendered the invention of claim 2 obvious within the meaning of Sec. 103.

Finally, the court determined that the facts did not support a holding of "egregious conduct" or fraud committed by Sohio either in procuring its patent or in bringing the infringement suit. It was apparently on this basis that the court made no award of attorney fees to the prevailing party, Cyanamid.

The opinion having been filed, judgment was thereafter entered simply dismissing the complaint with prejudice.

## OPINION

### A. Infringement

A patent confers the right to exclude others from making, using, or selling the invention defined by the claims. 35 USC Sec. 154. A determination of patent infringement under 35 USC Sec. 271(a) involves a two-step analysis of each asserted claim: first, the language of

the claim must be interpreted; and second, it must be determined whether the claim "reads on" the accused product or process, that is, whether the claimed invention is being made, used, or sold by the alleged infringer. The first is a question of law for the court, the second an issue of fact. See *Kalman v. Kimberly-Clark Corp.*, 713 F.2d 760, 771, 218 USPQ 781, 788-89 (Fed. Cir. 1983).

The requirements for the specification and claims are separately set forth in the first two paragraphs of 35 USC Sec. 112 (emphasis ours):

> The *specification* shall contain a written *description* of the invention, and of the manner of making and using it, in such full, clear, concise and exact terms *as to enable* any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same, and shall set forth the *best mode* contemplated by the inventor of carrying out his invention.
>
> The specification shall conclude with *one or more claims* particularly pointing out and *distinctly claiming* the subject matter which the applicant regards as his invention.

The allowability, or validity, of a claim depends, of course, on its subject matter meeting the statutory requirements for patentability and on the claim, per se, being "distinct"—i.e., having a clear and definite meaning when construed in the light of the complete patent document.

The second paragraph of Sec. 112 deals with the claims only. The first paragraph does not apply to claims but to "written description." It requires that the inventor adequately disclose three separate items: (1) the invention itself (the "description" requirement); (2) the manner and process of making and using the invention (the "enablement" requirement); and (3) the best mode con-

templated by the inventor, at the time of filing, in carrying out the invention (the "best mode" requirement). The descriptive part of the specification aids in ascertaining the scope and meaning of the claims inasmuch as the words of the claims must be based upon the description. The specification is, thus, the primary basis for construing the claims.

Finally, the prosecution history (sometimes called "file wrapper and contents") of the patent consists of the entire record of proceedings in the Patent and Trademark Office. This includes all express representations made by or on behalf of the applicant to the examiner to induce a patent grant, or, as here, to reissue a patent. Such representations include amendments to the claims and arguments made to convince the examiner that the claimed invention meets the statutory requirements of novelty, utility, and nonobviousness. Thus, the prosecution history (or file wrapper) limits the interpretation of claims so as to exclude any interpretation that may have been disclaimed or disavowed during prosecution in order to obtain claim allowance.

In its interpretation of claim 2 of the Greene reissue patent, the district court found that claim 2 is directed to a "process of hydrolyzing a nitrile with water" in the presence of a copper catalyst that consists of "a copper ion" which is "at least partially soluble." The key to interpreting claim 2 is, therefore, determining the exact nature of the "copper ion" catalyst used in the process.

The district court noted that the specification of the Greene reissue patent expressly states that "metallic copper when used alone is ineffective" in the process.[2] In

[2] While the record shows that this was the opinion of the patentees on the basis of their limited research, the record also shows that they were mistaken in their belief.

addition, the court noted that attorney Jones' response to the examiner's rejection of all claims in the reissue application pointed out that Watanabe disclosed the use of Urushibara copper, which "is in fact metallic copper which is outside [the] claims" of the reissue appliciation. By making this disclaimer or concession, Sohio surrendered any interpretation of its claim that would include metallic copper catalysts.

In determining whether the claim as thus interpreted reads on the Cyanamid process, the district court found that the Cyanamid process involved a "painstaking procedure to reduce certain copper compounds to pure metallic copper to perform a catalytic process that converts acrylonitrile to acrylamide," and that Cyanamid's catalyst "is a solid, insoluble catalyst, comprised of metallic copper, as pure as industrial chemical methods are capable of producing."

Comparing the two processes, the court found that the Greene reissue patent describes a catalyst that has copper ions in solution (a homogenous catalyst), while the Cyanamid catalyst does not have copper ions in solution. The Cyanamid catalyst is, rather, a solid insoluble catalyst that is essentially metallic copper. The court properly concluded there was no infringement by Cyanamid on the basis of Sohio's disclaimer of the use of metallic copper and also because Cyanamid's catalyst was not "at least partially soluble in water, the nitrile, or both in water and nitrile" within the meaning of claim 2. We agree with this interpretation and finding of non-infringement and therefore affirm it.

B. Validity

We now turn to the issue of validity of claim 2 of the Green reissue patent. Section 282 of Title 35 provides that a party charged with infringement may assert several

bases for invalidity, including "any ground stated in part II of this title as a condition for patentability" (i.e., failure to satisfy, inter alia, any one of the requirements of novelty, utility, or nonobviousness, Secs. 101, 102, and 103) and "failure to comply with any requirement of Sections 112 or 251 of this title."

The district court held claim 2 of the Green reissue patent invalid for both indefiniteness under Sec. 112, second paragraph, and for obviousness under Sec. 103. We affirm both holdings.

1. **Indefiniteness**

The district court concluded that claim 2 was invalid because the term "partially soluble" was insufficiently precise to meet the "full, clear, concise and exact" requirement of 35 USC Sec. 112, first paragraph (the enablement requirement), which was a misapplication of the statute, and also correctly concluded that "partially soluble" was too vague to "partially point out and distinctly claim" the subject matter of the insertion as required by the second paragraph of Sec. 112, the claim requirement.

Although we agree claim 2 is invalid because of its failure to satisfy the requirement of distinctly claiming the invention, we point out that the first paragraph of Sec. 112 applies only to the disclosure portion of the specification, not to the claims. The error was harmless, however, because the court also applied the right statutory provision.

We affirm this ground for holding claim 2 invalid.

2. **Obviousness**

A patent may also be held invalid if the invention claimed does not satisfy the requirement for nonobviousness, 35 USC Sec. 103, which reads:

> A patent may not be obtained though the invention is not identically disclosed or described as set forth in

> section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

*Graham v. John Deere Co.*, 383 U.S. 1, 17-18, 148 USPQ 459, 467 (1966), thus articulated the test for determining obviousness under Sec. 103:

> [T]he scope and content of the prior art are to be determined; differences between the prior art and the claims at issue are to be ascertained; and the level of ordinary skill in the art resolved. Against this background, the obviousness, of the subject matter is determined. Such secondary considerations as commercial success, long felt but unsolved needs, failure of others, etc., might be utilized to give light to the circumstances surrounding the origin of the subject matter sought to be patented. As indicia of obviousness or nonobviousness, these inquiries may have relevancy.

In considering the obviousness issue, the district court stated that "a hypothetical inventor is envisioned as working in his shop with all the prior art references —which he is presumed to know—hanging on the walls around him," citing in support a 1982 District of Delaware opinion.[3] The court then proceeded, however, to determine

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[3] This visual imagery originated, however, in 1966 in our predecessor court in the case of *In re Winslow*, 365 F.2d 1017, 151 USPQ 48 (CCPA 1966). It has attained an unfortunate popularity with the judiciary. In the nearly two decades since that opinion, this court and the CCPA considerably modified their views. As may be seen from *Winslow*, the picturesque phraseology was born out of a disagreement with the late Judge Arthur Smith who vigorously dissented on the obviousness issue. It was rather promptly modified by the CCPA in *In re Antle*, 444 F.2d 1168, 168 USPQ 717 (CCPA 1971).

that the real inventor, Dr. Greene, possessed the requisite skill, "by virtue of her Ph.D. in Chemistry," to be personally charged with knowledge of both of the prior art references, the Reppe patent and the Watanabe article. While the court's holding that claim 2 of the Greene reissue patent defined an obvious invention was correct, the court's reasoning in reaching that conclusion was based on some all-too-often misconstrued and now obsolete principles of the obviousness inquiry.

The issue of obviousness is determined entirely with reference to a *hypothetical* "person having ordinary skill in the art." It is only that hypothetical person who is presumed to be aware of all the pertinent prior art. The actual inventor's skill is irrelevant to the inquiry, and this is for a very important reason. The statutory emphasis is on a person of *ordinary* skill. Inventors, as a class, according to the concepts underlying the Constitution and the statutes that have created the patent system, possess something—call it what you will—which sets them apart from the workers of *ordinary* skill, and one should not go about determining obviousness under Sec. 103 by inquiring into what *patentees* (i.e., inventors) would have known or would likely have done, faced with the revelations of references. A person of ordinary skill in the art is also presumed to be one who thinks along the line of conventional wisdom in the art and is not one who undertakes to innovate, whether by patient, and often expensive, systematic research or by extraordinary insights, it makes no difference which. See the last sentence of Sec. 103, supra.

It was up to the court here to determine the level of skill of the hypothetical person of *ordinary* skill and what that person would have been able to do when in possession of the prior art, the scope and contends of which the court

has also determined. For a more extensive, and the latest, discussion of this court's views on who is presumed to know the prior art, see *Kimberly-Clark Co. v. Johnson & Johnson*, 745 F.2d 1437, 1449-1454, 223 USPQ 603, 610-614 (Fed. Cir. 1984).

Although the court here correctly determined the level of skill and prior art questions, the court's discussion of what skill Dr. Greene possessed was beside the point for the reasons discussed in *Kimberly-Clark*. The relevant inquiry was the court's assessment of the two prior art references. In that regard, the court specifically found that the Reppe patent discloses the use of a metallic copper catalyst to convert a nitrile to an amide. Example 2 of Reppe discloses conversion of an aliphatic nitrile to a small amount of aliphatic amide using a metallic copper catalyst. The Watanabe article teaches that a type of metallic copper, Urushibara copper, is a useful catalyst for converting at least one aromatic nitrile, benzonitrile, to its corresponding amide, benzamide. The court found that the combined teachings would have indicated to one of ordinary skill in the art that copper was an effective agent for producing a catalysis in the process of converting a nitrile to an amide.

Sohio contends that the district court ignored secondary indicia of nonobviousness, including the fact that "every known manufacturer of acrylamide now uses a one-step catalytic process." However, the fact is that Sohio has never licensed the Greene reissue patent to any of these manufacturers, and Sohio itself never used the process commercially. There evidently being no "secondary considerations" respecting the actual invention of claim 2, the district court's conclusion of obviousness of the subject matter of claim 2 was entirely correct.

C. Attorney Fees

Section 285 of Title 35 provides that a district court "in exceptional cases may award reasonable attorney fees to the prevailing party." In this case, both parties sought attorney fees in the court below, Sohio accusing Cyanamid of willful infringement and Cyanamid accusing Sohio of bringing a "baseless" infringement suit. Cyanamid also asserted that Sohio consciously failed to disclose the Watanabe reference during prosecution of the original patent application and misrepresented to the PTO the date when it first became aware of the Watanabe reference.

The district court found that neither Dr. Greene nor any other agent of Sohio was guilty of fraud or gross negligence in the PTO, concluding instead that a finding of simple negligence or oversight was more appropriate. Although a finding of inequitable conduct or "fraud in the Patent and Trademark Office" is often a basis for a district court to find that a case is "exceptional," it is not a prerequisite to an award of attorney fees under Sec. 285.

Circumstances other than inequitable conduct in the procurement of a patent may support a finding of an "exceptional" case. Other exceptional circumstances include willful infringement, misconduct during litigation, vexatious or unjustified litigation, or a frivolous suit. *See, e.g., Bayer Aktiengeselleschaft v. Duphar International Research B.V.*, 738 F.2d 1237, 1242, 222 USPQ 649, 652 (Fed. Cir. 1984); *Hughes v. Novi American, Inc.*, 724 F.2d 122, 125, 220 USPQ 707, 710 (Fed. Cir. 1984); *Stickle v. Heublein, Inc.*, 716 F.2d 1150, 11646, 219 USPQ 377, 387 (Fed. Cir. 1983); *Orthopedic Equipment Co. v. All Orthopedic Appliances*, 707 F.2d 1376, 1384, 217 USPQ 1281, 1287 (Fed. Cir. 1983).

The district court, so far as we can determine, made no definitive finding on the issue of exceptional case and did not specifically deny an award of attorney fees to the

prevailing party, Cyanamid. Because a court may award attorney fees in a case where circumstances demonstrate that litigation is baseless, as Cyanamid contends it is here, we remand this case to the district court for a determination of whether it is exceptional within the meaning of Sec. 285 and in light of the foregoing precedents.

## CONCLUSION

The judgment of the district court with respect to the issues of validity and infringement is *affirmed*, and the case is *remanded* to the district court to determine whether an award of attorney fees to the prevailing party under Sec. 285 is warranted.

**AFFIRMED AND REMANDED.**

UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF LOUISIANA.

**The DOW CHEMICAL COMPANY,**

*Plaintiff,*

*v.* Civ. A. No. 82-2355.

**AMERICAN CYANAMID COMPANY,**

*Defendant.*

August 15, 1985

**OPINION**

BEER, District Judge.

The Dow Chemical Company[1] ("Dow") instituted this action against American Cyanamid Company[2] ("Cyanamid") seeking injunctive relief and damages based on Cyanamid's alleged infringement of Dow's U.S. Patent No. 3,631,104 ("the '104 patent"), Reissue Patent No. 31,430 ("the '430 reissue patent"), U.S. Patent No. 3,994,973 ("the '973 patent"), U.S. Patent No. 3,642,894 ("the '894 patent"), U.S. Patent No. 3,758,578 ("the '578 patent"), and Reissue Patent No. 31,356 ("the '356 reissue patent"). Four of these patents, the '104 patent, the '430 reissue patent, which is the reissue of the original '104 patent, the '973 patent and the '894 patent claim the

[1] The Dow Chemical Company is a corporation existing under the laws of the State of Delaware with its principal place of business in Midland, Michigan, and having a regular place of business in the Eastern District of Louisiana.

[2] American Cyanamid Company is a corporation organized and existing under the laws of Maine with its principal place of business in Wayne, New Jersey, and having a regular place of business in the Eastern District of Louisiana.

chemical process of hydration[3] of acrylonitrile to acrylamide in the presence of a reduced copper oxide catalyst,[4] and thus are collectively referred to as the "oxide" patents. The remaining two patents, the '578 patent and the '356 reissue patent, which is the reissue of the original '578 patent, claim the process of hydration of acrylonitrile to acrylamide using a catalyst prepared by the reduction of copper salt, and hence are referred to as the "salt" patents.

Cyanamid has denied any infringement, and has counterclaimed for declaration that the Dow patents are invalid, unenforceable and not infringed.

By stipulation of the parties dated January 28, 1985, the damage issues were bifurcated.

This Court has jurisdiction over the subject matter of this action pursuant to 28 U.S.C. § 1338(a). Venue is proper in the Eastern District of Louisiana pursuant to 35 U.S.C. § 1400(b).

This case was tried to the Court sitting without a jury from March 21, 1985 through April 3, 1985. Having thereafter considered the very comprehensive briefs and accompanying data and then taken the matter under consideration, I now make the following findings of fact and conclusions of law. To the extent that any findings of fact constitute conclusions of law, they are adopted as such; to the extent that any conclusions of law state findings of fact, they are so adopted.

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[3] A hydration is a reaction in which a molecule of water attaches to another molecule. In this instance, hydration means that a molecule of water attaches itself to the nitrile group (–CN) of acrylonitrile ($CH_2=CH–CN$) to form acrylamide ($CH_2=CH–CONH_2$).

[4] A catalyst is a material which will affect a chemical reaction without the catalyst itself being consumed in the reaction. The process of conversion of chemicals in the presence of a catalyst is known as catalysis.

## FINDINGS OF FACT

### I. BACKGROUND

This controversy centers around the processes used by Dow and Cyanamid to manufacture an organic chemical compound known as acrylamide. The acrylamide formed from such processes is of great commercial value in that it can be converted into polymers which presently have varied uses in numerous commercial applications including enhanced oil recovery, municipal and industrial water treatment, pulp and paper processing, textile treatment and food processing.

Beginning in 1954, Cyanamid manufactured acrylamide using a sulfuric acid process. In the sulfuric acid process, acrylonitrile is mixed slowly with sulfuric acid and water under controlled conditions to produce acrylamide sulfate. The acrylamide sulfate is decomposed to acrylamide by reaction with ammonia, resulting in the formation of large quantities of ammonium sulfate as a by-product.

Dow also initially manufactured acrylamide by the sulfuric acid process. However, due to the serious waste disposal problem generated by the formation of by-products in the process, Dow initiated research in 1967 with the purpose of discovering a better method. Dow instructed one of its research chemists, Dr. Ben A. Tefertiller, to research a commercially viable alternate process which would utilize a heterogeneous catalyst.[5]

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[5] Catalysts are either homogeneous or heterogeneous. Homogeneous catalysts are used in the same phase, most often liquid, as the reactants, and the reaction thus occurs anywhere in the reaction mixture. Heterogeneous catalysis involves the use of a material which is in a different phase from that of the reactants. Heterogeneous catalysis usually involves the reaction of gaseous or liquid reactants with a solid catalyst. In heterogeneous catalysis, the reaction takes place on the surface of the catalyst and involves the absorption of the reactants onto the surface, the reaction of such on the surface, and the desorption of the reaction products from the surface.

In reviewing the literature prior to initiating his experimental work, Dr. Tefertiller considered the disclosures on heterogeneous catalysis in Mahan U.S. Patent 2,421,030; publications of Dr. Watanabe entitled "Studies of Organic Catalytic Reactions II.—The Hydration of Nitriles to Amides With Nickel Catalysts", 37. Bull.Chem. Soc'y Japan, 1325 (1964), "Studies on Organic Catalytic Reactions III.—The Hydration Mechanism of Nitriles to Amides With Nickel Catalysts" 39 Bull.Chem.Soc'y Japan, 8 (1966), (Watanabe III); and also on article by Cook and Forbes entitled "Solid Phase Catalysis of the Hydrolysis of Nitriles to Amides", 5 Chemical Communications, 121 (1966).

Using the heterogeneous catalysis disclosed in the Mahan U.S. Patent 2,421,030, Dr. Tefertiller was unable to convert acrylonitrile to acrylamide in any significant quantities. He then employed metallic nickel catalysts as disclosed by Watanabe for the hydration of acrylonitrile to acrylamide, but found that the major product of that reaction was proplonitrile, a hydrogenated product of acrylonitrile, rather than acrylamide. No further work was done on such catalysts by Dr. Tefertiller.

The Cook et al. reference disclosed the use of manganese dioxide to convert acrylonitrile to acrylamide in methylene chloride. In deviating from the teachings of the Cook et al. article, Dr. Tefertiller discovered that the hydration of acrylonitrile to acrylamide with manganese dioxide catalysts could be improved if the hydration was carried out in the presence of water using a particular form of manganese dioxide. In attempting to develop the use of manganese dioxide, Dr. Tefertiller found that in a continuous reaction system the manganese dioxide quickly became poisoned, resulting in the formation of polymeric by-products. The attempts to use manganese dioxide as a catalyst were consequently abandoned by Dr. Tefertiller.

The initial experimental work of Dr. Tefertiller on review of the literature demonstrated that the closest prior art did not suggest a catalyst which could be utilized in a viable process for the hydration of acrylonitrile to acrylamide. However, in 1967 Dr. Tefertiller, discovered that zinc and cadmium chromites gave encouraging results in the hydration of acrylonitrile. In order to test a wide variety of zinc and cadmium chromites, Dr. Tefertiller, who was now working in collaboration with Dr. Clarence E. Habermann, decided to prepare experimental catalysts. Such preparation included reducing zinc and cadmium chromates with hydrogen to form the corresponding chromites. In late 1968, Dr. Habermann and Dr. Tefertiller discovered that hydrogen reduction of the zinc and cadmium chromates resulted in improved catalytic activity in the hydration of acrylonitrile to acrylamide. In connection with the testing of reduced chromate catalysts for the hydration of acrylonitrile to acrylamide, Dr. Tefertiller and Dr. Habermann jointly discovered that copper zinc compounds, and other copper compounds as well, were active catalysts.

In the period of January to March of 1969, Dr. Tefertiller and Dr. Habermann discovered that reduced copper catalysts obtained by the reduction[6] of copper oxide, when employed in a continuous manner for the

[6] Reduction is a process by which the valance state of a compound is changed. In the case at hand, the valance state of copper contained in the compound is sought to be reduced from one of the copper-plus states to CU*. Thus, divalent cupric oxide ($CU_3O$) is reduced when it forms the monovalent cuprous oxide ($CU_2O$). The cuprous oxide can be further reduced to copper metal (CU). A variety of reducing agents cause this transformation of the two valent copper to the metallic stage, although the one that is preferred and commercially employed is hydrogen.

hydration of acrylonitrile to acrylamide, resulted in high yields of acrylamide and high conversion of acrylonitrile for long periods of time, without significant formation of by-products. The particular catalysts employed were reduced chromium-copper oxide catalysts which on reduction were passivated by gradual exposure to oxygen to prevent rapid oxidation. These catalysts, furthermore, were tested in continuous unit from which air was excluded during the reaction.

The discovery of using a reduced copper oxide catalyst was recognized to be a breakthrough in technology because of that catalyst's high selectivity in forming acrylamide without significant by-product, its high conversion of acrylonitrile to acrylamide and its long life. A number of catalysts obtained by the reduction of various copper compounds, including metallic copper obtained by the reduction of copper oxide were tested. The reduced Harshaw Cu 0203 was found to be the most effective catalyst for the hydration of acrylonitrile to acrylamide, as will be hereafter discussed.

In March of 1969, Dr. Habermann and Dr. Tefertiller, working with Ralph E. Friedrich, discovered that the careful exclusion of oxygen, not only from the reduced catalyst but also from the feed streams, resulted in still further improvements of the yield, selectivity life of the catalyst, and quality of the acrylamide product in its further use to form polyacrylamide. In view of the encouraging results obtained by Dr. Habermann and Dr. Tefertiller, Dow management scaled the laboratory process upward by a factor of almost 300,000, constructing a full scale commercial plant without any intermediate pilot plants which were usually built and tested before design of a full sized plant. In May, 1970, Dow started up its commercial plant using its reduced copper oxide catalyst and has continued to operate it for the commercial hydration of acrylonitrile to acrylamide.

Subsequent to the start-up of Dow's commercial plant, the reactors plugged due to polymerization. Dow formed a task force to define and solve the problem, which had not occurred in the laboratory tests run by Dr. Tefertiller. The plugging due to polymerization was determined to be caused by stagnant areas in the reactors. The plugging was not the result of the chemistry of the process, but rather, the chemical engineering of scaling-up the laboratory invention. Dow's polymerization problem was solved by maintaining a continuous flow of the reaction medium and increasing velocity of the flow by recirculation of the reaction medium.

## II. THE PATENTS IN SUIT

### A. The '104 Patent

Dow sought and obtained patents on its invention, which are here at issue. The '104 patent was applied for in the United States Patent and Trade Office by Dr. Habermann and Dr. Tefertiller on June 23, 1969, as a continuation in-part of an earlier patent application, filed on January 16, 1969, which matured into U.S. Patent 3,597,481 ("the '481 patent"). The '481 patent discloses (in Example 2) the preparation of a catalyst by the reduction of a copper oxide, and (in Example 4) discloses the use of such catalyst in the hydration of acrylonitrile to acrylamide. This was the first U.S. patent disclosure by Dow of reduced copper oxide catalysts.

The '104 patent discloses the use of a copper catalyst obtained by the reduction of copper oxide, copper-chromium oxide, copper-molybdenum oxide or mixtures thereof, in a continuous flow reaction for the hydration of acrylonitrile. The patent was issued on December 28, 1971, as U.S. Patent 3,631,104. The examples of the '104 patent describe the hydration of acrylonitrile to acrylamide using various reduced copper oxide containing catalysts in a

continuous flow reactor. Example 8, employing a reduced Harshaw copper oxide catalyst which had been protected from exposure to oxygen, was stated by Dr. Tefertiller, to be the best mode of practicing the invention.

Claim 26 of the '104 patent, which Dow asserts is infringed by Cyanamid, reads, in independent form, as follows:

> In a process for converting a nitrile to the corresponding amide by contacting acrylonitrile in the presence of water with a heterogeneous catalyst, the improvement comprising using a cupreous catalyst consisting essentially of reduced copper oxide, reduced copper-chromium oxide, reduced copper-molybdenum oxide, unreduced copper-molybdenum or mixtures thereof.

On January 16, 1970, Dow caused to be filed in Belgium a patent application corresponding in scope to the '481 and the '104 patent, such application having been published in Belgium on July 16, 1970 as Belgian Patent No. 774,543. Example 7 of the Belgian patent corresponds to Example 8 of the '104 patent.

**B. The '894 Patent**

The '894 patent was applied for in the United States Patent Office by Dr. Habermann and Dr. Tefertiller on December 5, 1969, as a continuation-in-part of the '104 patent, and issued on February 15, 1972, as U.S. Patent 3,642,894. The '894 patent discloses that catalyst life and product quality in the hydration of acrylonitrile using reduced copper oxide catalyst are improved by protecting the reduced catalysts from contact with oxygen after reduction. Claim 6 of the '894 patent, in independent form, reads as follows:

> In the process for catalytically hydrating acrylonitrile to the corresponding amide by contacting a reactant

feed of water and acrylonitrile with a reduced copper oxide or reduced copper chromite catalyst, the improvement comprising at least partially protecting the reduced catalysts from contact with oxygen after reduction.

**C. The '973 Patent**

On June 28, 1971 Dr. Habermann and Dr. Tefertiller filed, as a further continuation-in-part of the '104 patent, a patent application which issued on November 30, 1976, as U.S. Patent 3,994,973. The '973 patent discloses that for unsaturated nitriles (i.e., acrylonitrile) which tend to polymerize, a reaction temperature of less than about 200° C, a polymerization inhibitor or dilute reaction solutions are desirable to avoid polymerization of the nitrile and possible poisoning of the catalyst. ('973 patent, Column 6, lines 3-7). The patent also discloses, as does the '104 patent and '894 patent, the preference for a continuous flow reaction wherein the rate of flow of reactants over the catalyst is controlled to give desired contact of the reactants with the catalyst. Claim 13 of the '973 patent reads in independent form as follows:

> In the process for converting acrylonitrile to the corresponding amide by reacting the acrylonitrile with water in the presence of a catalyst, the improvement comprising conducting the reaction in the presence of a catalytic amount of copper prepared by reducing copper oxide.

**D. The '578 Patent**

On June 28, 1971, Dr. Habermann and Dr. Tefertiller filed an application disclosing and claiming the use of a reduced copper salt or hydroxide for the hydration of acrylonitrile to acrylamide. That application issued as U.S. Patent 3,758,578. The '578 patent discloses, as does the '973, the preference for a continuous flow reaction, and suggest the dilution of reactants as a means of preventing

polymerization. Claim 10 of the '578 patent reads in independent form as follows:

> In the process for converting acrylonitrile to the corresponding amide by reacting the acrylonitrile with water in the presence of a catalyst, the improvement comprising conducting the reaction in the presence of a catalytic amount of copper prepared by reducing copper hydroxide or a copper salt.

**E. The '430 Reissue Patent**

On February 26, 1981, Dr. Habermann and Dr. Tefertiller filed for a reissue of the '104 Patent in order to have the Patent Office reexamine the patentability of the claims in the light of prior art and other grounds not considered in the original prosecution. The reissue application issued on October 25, 1983 as Reissue Patent No. 31,430. The inventors, Dr. Habermann and Dr. Tefertiller, cited a number of references to the Patent Office for its consideration in the reexamination of the claims including four Watanabe references, the Kobayashi patent publication No. 44-5205, the German Reppe patent No. 552,987 and the Greene et al. patent U.S. No. 3,381,034. In conjunction with the filing of the reissue the inventors also submitted a preliminary argument and an affidavit to remove as a reference the Kobayashi patent publication 44-5205. The affidavit stated that prior to the effective date of the Kobayashi patent publication Dow's inventor Dr. Habermann had conducted an experiment in which he had reduced copper oxide to essentially copper metal, and had successfully tested such reduced catalyst in the hydration of acrylonitrile to acrylamide.

In response to Dow's submission, the Patent Office did not cite Kobayashi as prior art in its first Office Action. In a later Office Action the Patent Office expressly held the affidavit to be effective in eliminating the Kobayashi patent publication as a reference.

The Patent Office allowed claims 11, 12, 25 and 26 of the '104 patent over the prior art stated, which said claims read on the hydration of olefinic nitriles of 3 to 6 carbon atoms to their corresponding amides. Broader claims referring to aliphatic nitriles were held to be unpatentable over the Reppe German patent. The inventors thus limited the claims of the '430 reissue to the hydration of olefinic nitrites (which includes acrylonitrile) with a cupreous catalyst of copper, copper-oxide, copper-chromium oxide, copper-molybdenum oxide or mixtures thereof. Claims 1, 12, 16 and 26 of the '430 reissue were carried over from the '104 patent and are identical in scope and language to Claims 11, 12, 25 and 26 of the '104 patent. Claim 26 of the '430 reissue patent thus reads in independent form:

> In a process for converting a nitrile to the corresponding amide by contacting acrylonitrile in the presence of water with a heterogeneous catalyst, the improvement comprising using a cupreous catalyst consisting essentially of reduced copper oxide, reduced copper chromium oxide . . .

**F. The '356 Reissue Patent**

On February 26, 1981, Dr. Habermann and Dr. Tefertiller also applied for reissue of the '578 patent. The reissue application was granted by the Patent Office and was reissued on August 23, 1983 as Reissue Patent No. 31,356. The '356 reissue application was filed concurrently with the '430 reissue application and was examined in the Patent Office by the same Examiner. The same prior art and the same affidavit were submitted to the Patent Office as were submitted in the '430 reissue. In the prosecution of the '356 reissue, similar to the '430 reissue, the Patent Office held claims to the hydration of olefinic nitriles to be patentable over all the prior art cited and held the affidavit effective to eliminate the Kobayashi patent publication as a prior art reference. Claims 1 and

10 of the '356 reissue patent are identical in scope and language to Claims 9 and 10 of the original '578 patent. Claim 10 of the '356 reissue reads in independent form as follows:

> In the process for converting acrylonitrile to the corresponding amide by reacting the acrylonitrile with water in the presence of a catalyst, the improvement comprising conducting the reaction in the presence of a catalytic amount of copper prepared by reducing copper hydroxide or a copper salt.

During the presecution of the '430 reissue and '356 reissue patents, the U.S. Patent Office reviewed Cyanamid' charges that Dow had engaged in inequitable conduct and fraud on the Patent Office. After investigating the claim, the Patent Office concluded that there was insufficient evidence on which to base a holding of misconduct on the part of Dow or its inventors.

## III. CYANAMID'S PROCESS

Cyanamid concedes that it produces acrylamide at its production plant in Fortier, Louisiana, by passing acrylonitrile mixed with water over a heterogeneous metallic copper catalyst. Cyanamid also admits that despite Dow's refusal to license its technology, it utilized a hydrogen-reduced Harshaw Cu 203 catalyst, as disclosed in Example 8 of the '104 patent and in the '973 and '894 patents, at the Fortier plant in 1973 through 1974 and again from late 1977 to mid 1978.

The dispute between the parties thus centers around Cyanamid's current use of a hydrogen-reduced commercial catalyst purchased from BASF Corporation ("BASF"), which is known as the BASF R3-11. Dow claims that Cyanamid's use of the BASF catalyst infringes its patent because the catalyst contains copper oxide

which is reduced to the copper metal state for use as a heterogeneous catalyst, and that malachite contained in the catalyst proceeds through a two-step reduction phase, with the reduction of malachite to copper oxide, and then copper oxide to copper metal. Cyanamid maintains that the catalyst does not contain copper oxide, and that the reduction of malachite proceeds directly to the copper metal state without an intermediate phase of copper oxide.

**A. Cyanamid's Acquisition and Analysis of the BASF Catalyst.**

In May, 1973, BASF informed Cyanamid that the R3-11 commercial catalyst, when reduced with hydrogen to metallic copper, was a highly efficient catalyst for the hydration of acrylonitrile to acrylamide. BASF claimed that prior to reduction, the catalyst consisted essentially of copper silicate, and therefore was outside of the scope of any Dow patent claims because it did not contain any copper oxide. BASF also claimed that no copper oxide was formed during the reduction phase.

Following receipt of catalyst samples from BASF, Cyanamid conducted x-ray analysis and found, contrary to BASF's assertions, that the catalyst contained both copper oxide and malachite. Further analyses conducted by Cyanamid showed that after being heated for 18 hours at 320°C, the malachite phase was no longer observed and the catalyst was comprised of more copper oxide than the unheated sample. Based on an analysis of the chemical contents of the catalyst, Cyanamid believed that the BASF catalyst was comprised of 34% malachite and 9.7% copper oxide. In internal documents, Cyanamid conceded that the BASF catalyst was not completely free of the Dow patents.

Cyanamid thus requested BASF to produce a copper-oxide free catalyst. In September, 1973, BASF assured Cyanamid that it would be able to supply a catalyst which contained less than 5% of copper oxide as requested by Cyanamid. Dr. Laszlo Marosi of BASF prepared a report based on his analyses of the catalyst which asserted that the catalyst contained 1-2% copper oxide. Dr. Marosi also testified at trial that he has been unable to detect any copper oxide in the material supplied to Cyanamid for use as a catalyst. With BASF's assertions regarding the nonexistence of copper oxide in the catalyst, Cyanamid took a license under the BASF technology without independently verifying BASF's analyses. In fact, Dr. Siegel of Cyanamid, initially performed tests on the "new" catalyst only to find that it contained 5-10% copper oxide. No further analyses were conducted at that time; instead, Cyanamid relied on BASF's assertions.

**B. Two-Step Reduction of the BASF Catalyst**

BASF also informed Cyanamid that the catalyst would reduce directly to copper metal without first passing through an intermediate copper oxide phase by reducing the catalyst at a temperature range of 160°C to 230°C with the gradual introduction of hydrogen. BASF demonstrated that by following this procedure and observing the process with x-ray analysis, the reduction proceeded in one step directly to copper metal. However, Cyanamid's reduction of the catalyst on December 15, 1973, at the Fortier plant indicated that "in actuality, two distinct steady state reduction stages were observed in the plant reactor." (P-192, pg. 3). The first step involved the reduction of malachite and copper compounds to cuprous oxide, and the second step involved the reduction of the cuprous oxide to copper metal. Based on these experiments, Cyanamid knew (or should have known) that

the BASF catalyst was reduced by the same two step procedure, as was the Harshaw Cu 203 catalyst.

Prior to trial, Cyanamid again ran analyses of the reduction of the BASF catalyst at a temperature of 210°C, which is in accordance with the reduction process used at the Fortier plant. Cyanamid's expert witness testified that the reduction occurred so rapidly that there was no "visual" evidence in the analyses employed to indicate that an intermediate phase of cuprous oxide was formed during the reduction. Based on this alleged lack of visual or graphic verification, Cyanamid's experts concluded that the copper components comprising the catalyst reduced directly to copper metal without first passing through an intermediate copper oxide phase.[7]

**C. Dow's Analyses of the BASF Catalyst**

Dow's visual inspection under a microscope of the R3-11 catalyst as purchased by Cyanamid from BASF reveals dark brown areas which are rich in copper oxide, and light blue and green areas which are mainly malachite. The visual examination conducted by Cyanamid in 1973 also showed the catalyst to exhibit the same appearance. These independent visual inspections of the BASF R3-11 catalyst show that no significant change in catalyst composition took place between 1973 and 1984.

Tests performed by Dow in 1983-84 established the malachite (basic copper carbonate) content to be 31%. Cyanamid's tests at this time period established the malachite to be 35.4% in one test and 30.3% in another

[7] For such use as a reviewing court may wish to accord my observations on this point, I feel obliged to say that I felt Cyanamid's experts were somewhat equivocal in their testimony. They obviously did not want to be untruthful and thus, they struggled mightily to "reach conclusions" rather than come directly to grips with the issue.

test. The malachite content of the BASF catalyst as determined by Cyanamid in 1973 was 34%. Thus, Cyanamid's malachite determinations in 1973 and 1984 show that no significant changes have taken place in the malachite content of the catalyst.

Dow established by quantitative x-ray analysis that the current BASF R3-11 catalyst employed by Cyanamid contains 14% copper oxide. The reliability of Dow's x-ray data was confirmed by independent elemental analyses. The analyses conducted by Dow demonstrate that substantially all of the copper present in the catalyst is accounted for by the copper in the copper oxide and by the copper in the malachite. No significant quantities of other copper compounds are traceable.

Dow also performed analyzes proving that the reduction of the BASF R3-11 catalyst proceeds through two-steps with the intermediate formation of copper oxide. X-ray analysis conducted by Dow's Dr. Timothy G. Fawcett on the BASF R3-11 catalyst demonstrates that when the catalyst is reduced at 300°C the reduction takes place in two steps with the intermediate formation of a copper oxide which is then reduced to copper metal. The fact that Dr. Fawcett's reduction experiment was conducted by 300°C does not affect its validity. The chemistry is essentially the same whether the reaction is carried out at 210°C or 300°C, with the intermediate formation of copper oxide. In reaching this conclusion, I have relied on the testimony of Dr. Ludo Frevel who I found to be entirely credible.

Dr. Fawcett further analyzed an x-ray photographic diffractogram generated by Dr. Marosi under conditions closely approximating those of the Cyanamid reduction process for the R3-11 catalyst. This analysis established that cuprous oxide forms as an intermediate in the reduction process.

Dow's analytical evidence thus establishes that the BASF catalyst contains both copper oxide and malachite, and reduces to copper metal by a two-step reduction which includes the formation of an intermediate cuprous oxide before going to the metal state.

## CONCLUSIONS OF LAW

Cyanamid argues that Dow's patents are invalid for the following reasons: 1) obviousness under 35 U.S.C. § 103; 2) failure to disclose the best mode of invention under 35 U.S.C. § 112; and 3) inequitable conduct and fraud on the Patent Office. Dow asserts that the patents are valid and that certain claims are infringed by Cyanamid. The validity of the patents will be addressed first, and thereafter infringement.

### I. PRESUMPTION OF VALIDITY

The starting point in analyzing a challenge to the validity of a patent is the presumption that the patent is valid, 35 U.S.C. § 282, with the burden of demonstrating invalidity by clear and convincing proof resting on the party asserting it. *American Hoist & Derrick Co. v. Sowa & Sons, Inc.*, 725 F.2d 1350 (Fed.Cir.1984). Cyanamid, therefore, has the burden of demonstrating, by clear and convincing evidence, the invalidity of the patents-in-suit and the invalidity of each claim it seeks to destroy. *See, Shelcore Inc. v. Durham Industries*, 745 F.2d 621 (Fed.Cir.1984).

While an Examiner's decision on an original reissue application is not binding on a court, it is evidence that the court considers in determining whether the presumption of validity has been overcome. In this case, the Examiner for the U.S. Patent & Trade Office considered

all of the relevant prior art and Cyanamid's contention of fraud in the prosecution of the patents. Since no prior art other than that which was considered by the Patent Office Examiner is relied on by Cyanamid in its defense, it "has the added burden of overcoming the deference that is due to a qualified government agency presumed to have properly done its job." *American Hoist*, 725 F.2d at 1359. Cyanamid has failed to meet its burden of proof, and thus the patents in suit have not been proved invalid on the various grounds asserted by Cyanamid.

## II. OBVIOUSNESS—33 U.S.C. § 103

33 U.S.C. § 103 provides that:

> "A patent may not be obtained . . . if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains . . ."

In assessing the nonobviousness or obviousness of a patent invention, certain factual inquiries are determined: (1) the scope and content of the prior art; (2) the level of ordinary skill in the art; (3) the differences between the claimed invention and the prior art; and (4) so-called "secondary" considerations, such as long felt need, unexpected results, commercial success and failure of others. *Graham v. John Deere Co.*, 383 U.S. 1, 17, 86 S.Ct. 684, 694, 15 L.Ed.2d 545 (1966). These secondary considerations, when present as they are in this case, are especially helpful in determining nonobviousness of a patent without falling prey to hindsight reasoning. *Atlas Powder Co. v. E.I. DuPont DeNemours and Co.*, 750 F.2d 1569, 1574 (Fed.Cir.1984).

The pertinent prior art includes the German Reppe patent, four Watanabe references, the Greene, et al.

patent, a Haefele patent and a 1967 lecture.[8] The German Reppe patent No. 522,987, entitled "Method for Hydrogenation of Nitriles of Unsaturated Acids", issued to Walter Reppe, et al. in 1932, the U.S. cognate being U.S. Patent No. 1,891,055. The Reppe patent teaches that metallic copper catalysts made by the reduction of copper compounds, such as copper carbonate, copper oxide or copper hydroxide are useful for the hydrogenation of unsaturated nitriles to the corresponding saturated nitriles. The Reppe patent also discloses that after the hydrogenation and separation of the catalyst from the reaction mixture, the saturated nitrile can be converted to the amide by the addition of water or water vapor using standard reaction methods. Reppe does not teach the reaction of a nitrile with water over the copper catalysts, and does not disclose the hydration of acrylonitrile to acrylamide using a reduced copper compound as a catalyst.

In 1959, Dr. Watanabe of Tokyo Metropolitan University published an article entitled "Studies of Organic Catalytic Reactions" (Watanabe I), 32 Bull.Chem. Soc'y. Japan, 1280 (1959), in which Watanabe described the use of metallic nickel catalysts for the conversion of some aromatic nitriles to their corresponding amides. In that article, the author also indicated that metallic copper catalysts could be used but stated that they were not as useful because of undesirable side reactions. In a second article entitled "Studies on Organic Catalytic Reactions II.—The Hydration of Nitriles to Amides with Nickel Catalysts", 37 Bull.Chem.Soc'y. Japan, 1324 (1964), Dr. Watanabe disclosed that the hydration of aliphatic nitriles was somewhat complicated and different from that of

[8] Since this Court agrees with and accepts the findings of the U.S. Patent Office in eliminating Kobayashi as prior art, there is no need to detail the teachings of the Kobayashi reference.

aromatic ones, and that the hydration was accompanied by side reactions forming acidic compounds. With respect to the use of metallic copper, Dr. Watanabe indicated that such materials gave poor results as catalysts for hydration and sometimes caused unexpected side reactions. In addition, Dr. Watanabe stated that some metallic copper species failed to give any hydration of nitriles to amides, but formed large amounts of complexes of corresponding amines. In addition, Dr. Watanabe taught that the catalysts could be exposed to air during their preparation and that city water could be used for their preparation. The reference does not disclose the hydration of acrylonitrile to acrylamide with a reduced copper compound as a catalyst.

The Watanabe reference entitled "Studies on Organic Catalytic Reactions III.—The Hydration Mechanism of Nitriles to Amides with Nickel Catalysts", 39 Bull. Chem.Soc'y. Japan, 8 (1966), confirmed Watanabe's earlier report that aliphatic nitriles gave poor results in his attempts to convert such to amides with nickel catalysts. Catalysts other than the nickel catalysts employed by Watanabe gave poor results with all nitriles. The reference does not disclose the hydration of acrylonitrile to acrylamide with a reduced copper compound as a catalyst.

The third Watanabe reference, entitled "Novel Reduction of Various Organic Compounds with Water in the Presence of Precipitated Metals", 41 Bull.Chem.Soc'y. Japan, 1902 (1968), discloses that metallic nickel and, to a lesser extent, metallic copper, would convert aromatic nitriles to amines instead of amides and that the same nickel catalysts convert unsaturated carbon-carbon double bonds to saturated bonds when such organic materials are reacted with water.

In 1968, United States Letters Patent 3,381,034, entitled "Process for Hydrolyzing Nitriles", was issued to

Janice L. Greene, et. al. The Greene, et al. patent taught that soluble copper ions would convert aromatic and aliphatic nitriles, including acrylonitriles, to their corresponding amides; it stated, however, that metallic copper alone was not an effective catalyst for converting acrylonitrile to acrylamide.

In January of 1968, United States Letters Patent 3,366,639 issued to Haefele disclosed the use of large amounts of manganese dioxide as a catalyst with an organic solvent to convert nitriles, including acrylonitrile, to the corresponding amide. The reference does not disclose the use of a reduced copper compound to catalyze the hydration of acrylonitrile to acrylamide.

The 1967 Lectures teach how to prepare metallic copper catalysts, but do not disclose the use of such catalysts in the hydration of a nitrile to an amide. These references are merely cumulative to the Reppe patent already discussed. The '104 patent in Column 2 acknowledges that the copper catalysts employed are known and can be prepared by conventional methods.

I conclude that there are differences between the subject matter claimed by Dow in the patent-in-suit and the prior art when taken as a whole, and that such differences would not be obvious to those skilled in the art. First, the references teach that the conversion of a nitrile to its corresponding amide is affected by the type of metal catalyst employed. The Greene et. al. reference taught explicitly that copper metal is not an effective catalyst for such a conversion. Thus, the hydration of nitriles by the use of a copper catalyst obtained through the reduction of a copper compound was not predictable, and was not obvious. Secondly, the inventions claimed in the Dow patents are limited to the conversion of certain unsaturated nitriles, particularly acrylonitrile to its correspond-

ing unsaturated amide. The process claimed in the Dow patents, therefore, differ from the prior art in the nature of the nitrile hydrated and the nature of the resultant amide. The difference in the chemical nature of the unsaturated nitriles claimed in the Dow patents, as compared to the saturated and aromatic nitriles[9] shown in the art, confirms that Dow's inventions were not obvious.

Secondary considerations of nonobviousness further support the conclusion that the Dow patents are valid. The long-felt need to find a better way to manufacture acrylamide than the then-existing sulfuric acid process is evidenced by the research efforts of Dow and Cyanamid. Both parties sensed the compelling need to develop a better method because of the waste disposal problem generated by the sulfuric acid process. Dow's efforts were successful, not only scientifically, but also commercially in that Dow was able to build a full-size plant utilizing its patented invention that replaced the sulfuric acid process. Further, Cyanamid admits that it utilized the process disclosed in the patent specifically with a Harshaw Cu 203 catalyst, thus indicating Cyanamid's frustrations in not being able to develop its own process based on prior art. These factors indicate that Dow's patented invention is not obvious in view of prior art.

## III. BEST MODE—35 U.S.C. § 112

Under 35 U.S.C. § 112, the applicant for a patent must include in his application a specification containing a "written discription of the invention" setting "forth the best mode contemplated by the inventor of carrying out his invention." The best mode required to be disclosed is

[9] Acrylonitrile and acrylamide are, respectively, unsaturated aliphatic nitriles and unsaturated amides; and hence, differ chemically from saturated nitriles and amides.

the best mode of practicing the invention that is known to the inventor at the time the application for the patent is filed. *W.L. Gore & Associates, Inc. v. Garlock, Inc.*, 721 F.2d 1540, 1556 (Fed.Cir.1983).

Cyanamid contends that the Dow patents are invalid for failure to disclose the best mode in that Dow did not disclose the problems of polymer formation and subsequent plugging of the reactor due to polymerization, and that Dow did not disclose that maintaining a high linear velocity of fluid through the reactor eliminates the polymer formation and subsequent plugging.

However, the essence of the invention in the Dow patents is the use of a reduced copper compound as a catalyst in the conversion of an unsaturated nitrile of its corresponding unsaturated amide, and not a method to prevent polymerization. Patents are written for those skilled in the relevant art, and thus, an applicant need not divulge every piece of information which a lay person would need to operate the invention most effectively.

The problem of polymer formation did not exist until 1971, significantly later than the filing dates of the applications maturing into the '104 and '894 patents. The disclosure in Example 8 of the '104 patent satisfies the best mode requirement as this method was the best way of practicing the invention at the time the application was made. The '430 reissue patent also is not invalid for disclosing the best mode, as it is the reissue of the original '104 patent, and no new matter can be added to a patent in a reissue proceeding. 35 U.S.C. § 251. Even though the polymerization problem had not occurred at the time of filing the application, the '104 and '894 patents disclose the preference for a continuous flow reaction wherein the rate of flow of reactants over the catalyst is controlled to give desired contact of the reactants with the catalyst. This disclosure satisfies the best mode requirement since the

use of continuous flow of reactant mixtures was later found to prevent polymerization.

The later patents, the '973, the '578 and the reissue '356 specifically disclose that in hydrating unsaturated nitriles (i.e., acrylonitrile) which tend to polymerize, a reaction temperature of less than 200°C, a polymerization inhibitor or the dilution of reaction solutions are desirable to avoid polymerization of the nitrile and subsequent poisoning of the catalyst. These patents also disclose the preference for continuous flow of reactant mixtures. The disclosure of a specific rate of flow of the reactant mixture is not necessary in order to meet the best mode requirement. "Where one of ordinary skill in the art would know how to select operating conditions so as to achieve a particular result, the failure to include a recitation of some specific operating conditions in the specification cannot give rise to a rejection . . . under the 'best mode' requirement of 35 U.S.C. § 112." *In re: Karnofsky*, 390 F.2d 994, 997 (C.C.P.A.1968), *see also General Motors Corp. v. U.S. International Trade Commission*, 687 F.2d 476 (C.C.P.A.1982). Further, the best mode requirement does not require the inventor to disclose production details so long as the means to achieve the inventive results are disclosed. *International Telephone & Telegraph v. Raychem Corp.*, 538 F.2d 453, 460 (1st Cir. 1976), *cert. denied*, 429 U.S. 886, 97 S.Ct. 238, 50 L.Ed.2d 167 (1976). *See also McGill, Inc. v. John Zink Co.*, 736 F.2d 666 (Fed.Cir.1984).

Here, Cyanamid's ability to copy and design a commercial process, and successfully manufacture acrylamide based on Example 8 of the '104 patent using the Harshaw Cu 203 catalyst confirms that Dow's patents-in-suit meet the best mode requirements.

## IV. INEQUITABLE CONDUCT

Cyanamid maintains that Dow engaged in inequitable conduct in the prosecution of its patents and reissue patents by failing to disclose prior known art, and then by fraudulently misrepresenting the nature of the catalyst used in experiments which were disclosed in an affidavit which caused the Patent Office to eliminate the Kobayashi reference.

A breach of the duty of candor owed to the U.S. Patent and Trade Office which renders a patent unenforceable occurs when material information is misrepresented or withheld, and such misrepresentation or withholding is intentional or accompanied by gross negligence or bad faith. *Hycor Corporation v. The Schleuter Co.*, 740 F.2d 1529, 1538 (Fed.Cir.1984). To establish inequitable conduct as a defense rendering a patent unenforceable, the party asserting this defense must prove, by clear and convincing evidence, the thresholds of materiality and intent. *Atlas Powder Co. v. E.I. DuPont DeNemours & Co.*, 750 F.2d 1569, 1578 (Fed.Cir.1984). Cyanamid has failed to demonstrate that Dow engaged in fraudulent conduct when prosecuting its patent claims. Since Cyanamid has failed in its burden of proof, this Court concludes that the '104, '587, '973 and '894 patents were duly and lawfully issued, and the '430 and '578 reissue patents were duly and lawfully reissued.

## V. INFRINGEMENT

35 U.S.C. § 271(a) provides that:

> "... whoever without authority makes, uses or sells any patented invention, within the United States during the term of the patent therefor, infringes the patent."

Dow asserts that the inventions covered by Claim 26 of the '104 patent and of the '430 reissue, Claim 6 of '894 patent, Claim 13 of the '973 patent and Claim 10 of the '578 patent and the '356 reissue of its patents have been copied by Cyanamid for the manufacture of acrylamide without license from Dow or lawful right.

The claims of a patent set forth the formal definitions of the invention and must be looked to in determining if there has been infringement. *Autogiro Co. of America v. United States*, 384 F.2d 391, 181 Ct.Cl. 55 (1967). Although the claims define the bounds of the patent, this Court is not confined to the language of the claims in interpreting their meanings. *Rel-Reeves, Inc. v. United States*, 534 F.2d 274, 209 Ct.Cl. 595 (1976). However, claim interpretation should be done on a reasoned basis to avoid unjust results. *Emery Industries v. Schumann*, 111 F.2d 209 (7th Cir.1940).

In determining whether there is an infringement of the patent by the accused process, the meaning of the claims in issue must first be ascertained. In interpretating the claims, it must be noted that terms of art in the claims specifically "comprising" and "consisting essentially of" have been previously defined. The term "comprising" permits the inclusion of other steps, elements or materials in addition to the elements or components specified in the claims. *In re: Baxter*, 656 F.2d 679, 686 (C.C.P.A.1981). The term "consisting essentially of" limits the scope of the claims to the specified ingredients, and those that do not materially affect the basic and novel characteristics of a composition. *In re: Herz*, 537 F.2d 549, 551 (C.C.P.A.1976).

Claim 26 of the '104 patent and of the '430 reissue patent reads, in independent form, as follows:

> In a process for converting a nitrile to the corresponding amide by contacting acrylonitrile in the

> presence of water with a heterogeneous catalyst, the improvement comprising using a cupreous catalyst consisting essentially of reduced copper oxide, reduced copper chromium oxide. . .

The issue of infringement with respect to this claim is whether the metallic copper in Cyanamid's reduced BASF R3-11 catalyst is obtained substantially or entirely through the reduction of copper oxide. Dow has proved by a preponderance of the evidence that the metallic copper in the reduced BASF catalyst is derived entirely from the reduction of copper oxide initially present in the catalyst and from copper oxide formed by the reduction of the malachite present in the catalyst. Accordingly, Claim 26 of the '104 patent and of the '430 reissue, as well as Claim 12, which reads, in pertinent part: "Contacting acrylonitrile in the presence of water with a heterogeneous cupreous catalyst consisting essentially of copper prepared by reducing copper oxide," have been infringed upon by Cyanamid.

Claim 6 of '894 patent reads, in independent form, as follows:

> In the process for catalytically hydrating acrylonitrile to the corresponding amide by contacting reactant feed of water and acrylonitrile with a reduced copper oxide or reduced copper chromite catalyst, the improvement comprising at least partially protecting the reduced catalysts from contact with oxygen after reduction.

The issue relative to infringement of this claim is whether Cyanamid's process and catalyst comply with exact terms of the claim. Dow has proved by a preponderance of the evidence that the BASF catalyst is a reduced copper oxide catalyst and that Cyanamid does protect the catalyst from exposure to oxygen after reduction and during hydration. Accordingly, Claim 6 of the '894 patent has been infringed by Cyanamid.

Claim 13 of the '973 patent reads, in independent form, as follows:

> In the process for converting acrylonitrile to the corresponding amide by reacting the acrylonitrile with water in the presence of a catalyst, the improvement comprising conducting the reaction in the presence of a catalytic amount of copper prepared by reducing copper oxide.

This claim differs from Claim 12 and 26 of the '104 patent in that it allows the presence of other catalytic species, but is infringed so long as catalytic amounts of copper obtained by the reduction of copper oxide are present. Dow has proven by a preponderance of evidence that the conditions called for by Claim 13 are satisfied by Cyanamid's process in utilizing the reduced copper oxide BASF catalyst; thus, this claim has also been infringed.

Claim 10 of the '578 patent and the '356 reissue patent reads, in independent form; as follows:

> In the process for converting acrylonitrile to the corresponding amide by reacting the acrylonitrile with water in the presence of a catalyst, the improvement comprising conducing the reaction in the presence of a catalytic amount of copper prepared by reducing copper hydroxide or a copper salt.

Claim 10 of the '578 patent and the '356 reissue differs from previously discussed Claim 26 of the '104 patent in two respects. First, said Claim 10 requires that a catalytic amount of copper in the catalyst be prepared by direct reduction of copper hydroxide or a copper salt; and second, the use of "comprising" permits the inclusion of other catalytic components in addition to the required catalytic amount of copper. The use in Cyanamid's process of a copper catalyst obtained by direct reduction of a copper salt would constitute infringement of said Claim 10.

However, since this Court has found that the metallic copper of Cyanamid's reduced BASF catalyst is produced by the reduction of copper oxide, the Cyanamid process does not infringe said Claim 10 of the '578 and the '356 reissue patents.

Although this Court has found that Cyanamid's process utilizing the BASF reduced copper oxide catalyst literally infringes Dow's '104 patent and '430 reissue, '894 patent and '973 patent, it must be further noted that Cyanamid's process also infringes the claims of these patents under the doctrine of equivalents. The doctrine, designed to protect a patentee from an infringer who appropriates the invention but avoids the literal language of the claim, allows a finding of infringement when the accused product and claimed invention performs substantially in the same way to yield substantially the same results. *Gravier Tank & Mfg. Co. v. Linde Air Products Co.*, 339 U.S. 605, 608, 70 S.Ct. 854, 856, 94 L.Ed.2d 1097 (1950); *Atlas Powder Co. v. E.I. DuPont deNemours*, 750 F.2d 1569, 1579 (Fed. Cir.1984). Cyanamid's use of the BASF catalyst performs the same process claimed in the Dow oxide patents in the same way disclosed, particularly since Cyanamid utilizes a reduction process and protects the catalyst from oxygen. Furthermore, Cyanamid's process utilizing the allegedly revised BASF catalyst produces high yields of pure acrylamide from the hydration of acrylonitrile, as does the Dow process disclosed in the invention.

Initially, Cyanamid realized that the original catalysts supplied by BASF contained copper oxide and other copper compounds which, when reduced, went through an intermediate copper oxide phase. The revised catalyst supplied by BASF allegedly contained no copper oxide or a miniscule amount so as to not infringe the patent. Regardless of BASF's assertion, it is apparent that the

original BASF catalyst and the alleged revised catalyst utilized in Cyanamid's process are obtained by the reduction of a copper compound, particularly malachite, with hydrogen. Both catalysts performed the same function in the same way with the same results, namely, the prosperous production of great yields of acrylamide with little or no by-product. The presence of malachite in the non-reduced catalyst does not allow Cyanamid to avoid infringement of the patents, especially since this Court has found that when reduced, the malachite in the BASF catalyst proceeds through an intermediate copper oxide phase.

## VI. INJUNCTION—35 U.S.C. § 154

The remedy of injunction for infringement is granted to the patent owner under 35 U.S.C. § 154, Congress having thus recognized that a patentee whose claims have been infringed should be entitled to exclude others, and reserve to himself, the right to practice his invention. Here, in view of Cyanamid's infringement of the patents in suit, Dow is entitled to an injunction enjoining Cyanamid for the remaining respective terms of the patents in suit from committing any further acts of infringment.

I find, however, that Cyanamid's infringement did not reach the degree of calculated and willful infringement which I perceive to be the basis for awarding treble damages and attorney fees under 35 U.S.C §§ 284 and 285, providing for such relief in "exceptional" cases.[10]

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[10] This is not to condone (my perception of) the relationship that existed between Cyanamid and BASF. Even the "tests" which Cyanamid used to "confirm" its comprehension that the BASF process did not infringe were, I think, marginal at best. But such doubts as I have had are not quite able to successfully compete with the presumption of moral regularity that Cyanamid is entitled to.

The remaining issue of damages, by stipulation of the parties, has been bifurcated, and therefore remains to be tried.

Counsel for Dow is hereby instructed to prepare a judgment in accordance with the foregoing.